AMERICAN ENGINEER AND RAILROAD JOURNAL.

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CONTENTS.

IF NOT, WHY NOT?

Possible Economies in Locomotives.

By Mr. M. N. Forney.

To the Editor:

In a recent issue one of your contemporaries makes the statement that "the indications are" that under similar conditions the coal consumption of the new "Northwestern type of locomotives"—which was illustrated in the July number of your excellent paper—"is about 20 per cent. less than with the standard eight-wheel engines, having smaller boilers and grates." The "Northwesterns" are simple or single-expansion locomotives. As there is a great deal of testimony afloat showing that compound locomotives also save 20 per cent. of fuel, could it be inferred that if the "Northwestern" engines were compounded they would save 40 per cent.—if not, why not?

It can also be proved theoretically and practically that for each 12 degrees that the feed-water is heated by the exhaust steam or waste gases, before the water enters the boiler, there will be an economy of 1 per cent. of fuel. Now steam of 200 lbs. pressure has a temperature of 388 degrees. That of the exhaust steam is about 235 degrees, and the waste gases vary from somewhere about 350 to 1,200 degrees. It would, therefore, seem to be entirely practicable to raise the temperature of the feed-water up to 300 degrees before it enters the boilers. If the feed-water has an initial temperature of 60 degrees the heat added would be equivalent to an economy of 20 per cent. more. If, then, a "Northwestern" locomotive was compounded and a feed-water heater was added, why would it not be possible to save 60 per cent. of the fuel?

The technical papers have recently had accounts of super-heaters tried in Europe on locomotives, and various economies have been claimed. From what has been accomplished by this means with stationary engines a saving of 10 per cent. would not seem extravagant. The addition of a super-heater in a locomotive ought then to carry the economy up to 70 per cent. If not, why not?

The introduction of wide fireboxes have also brought with them another problem. The big grate is undoubtedly very useful when a locomotive is working hard, but is quite too large when the loads and the grades are light, and the speed slow. Now to meet this difficulty the writer has designed a grate of which the open area can be increased or diminished as required, and can thus be adapted to the work to be done. It has never been tested, but a saving of 10 per cent of fuel by its use with a wide firebox, and thus improving the combustion, seems to be quite within the reach of possibility. This would carry our economy up to 80 per cent. If not, why not?

In France what are known as the "Serve" tubes have for some time been extensively used. As probably most of your readers know, these tubes have a number of longitudinal ribs on the inside whose purpose is to absorb the heat from the products of combustion and conduct it to the water on the outside of the tubes. Having no data at hand showing how much economy is effected by the use of these tubes, it will be assumed to be 10 per cent., which brings the total up to 90 per cent.

According to the testimony of master mechanics, locomotive superintendents and locomotive runners the world over, one of the most efficient fuel savers is a good fireman, and probably any amount of testimony could be obtained to the effect that the most skillful and intelligent firemen and engineers can easily run a locomotive with 10 per cent. less fuel than will be consumed by ordinary men. This would bring the economy up to 100 per cent. If not, why not?

We have not quite reached the perfection of the crank's cooking stove, which had so many appliances attached to it for saving fuel that he finally found he could use it for a refrigerator.

Of course there is a fallacy underlying all of the above irony—no pun intended. If the "Northwestern" type of locomotive saves 20 per cent. of fuel—the original consumption being, say 100—the latter would be reduced to 80. Now, if the compound system would save 20 per cent. it would then be 20 per cent., not on the original 100, but of 80 = 16, leaving 64 as the consumption. The feed-water heater might then save 20 per cent. of that, which would leave the consumption 51.2. By successively deducting the 10 per cent. economy of the super-heaters, 10 more for the improved grate, 10 for the Serve tubes and 10 for skillful engineers and firemen, and we will have left 37.4 as the consumption, or a saving of almost two-thirds.

Now probably no master mechanic or experienced locomotive superintendent would read a statement of even this kind without being disposed to thrust his tongue into his cheek and wink one eye. He would not only be skeptical about such a statement, but would probably be quite atheistical in his unbelief. But the economies cited above are well authenticated. There is no reason to doubt the statement of your contemporary that "the indications are that under similar conditions the coal consumption of the Northwestern engine is about 20 per cent. less than with standard eight-wheel engines having similar boilers and grates." From the reports of the economy of compound locomotives, which have been put out by the builders of them, it may fairly be inferred that they will guarantee that the fuel consumption of any simple engine will be reduced 20 per cent. by compounding it. The refrain—if not, why not? may, therefore, be repeated.

With reference to feed-water heaters, the only question of doubt involved is the possibility of heating the water from a temperature of about 60 degrees to 300 by means of the exhaust steam and waste gases. To heat a pound of water of that initial temperature up to 300 degrees will require 240 units of heat. Taking the average pressure of the exhaust steam at eight pounds it will contain 1,185 units of heat, or 1,125 more than it did when it was feed-water.

The amount of air required to burn each pound of coal in a locomotive boiler may be taken at 17 lbs. As this combines in various ways with the coal the weight of the products of combustion would be 18 lbs. for each pound of coal burned. If the average temperature of the gases be taken at 600 degrees and their specific heat at one-quarter that of water, each pound

of the gas would contain 135 units of heat counted from a temperature of 60 degrees, so that for each pound of coal burned there would be 135 x 18 = 2,430 units of heat in the gases escaping out of the chimney for each pound of coal burned. If 7 lbs. of water are evaporated per pound of coal there would be 347 units of waste heat escaping from the chimney in the gases for each pound of water evaporated. This added to the 1,125 in the exhaust steam gives 1,472 units of waste heat which escapes for each pound of water evaporated. As it requires only 240 units to raise the feed-water from a temperature of 60 to 300 degrees it will be seen that there is an abundance of waste heat to do what is proposed if we can only catch it before it escapes. A saving of 25 per cent. by heating the feed-water, therefore, seems quite possible. Of course there are difficulties, the chief one being that of providing sufficient heating surface in a feed-water heater.

That a very great economy results from super-heating steam has been shown very often both by theory and practice. Authorities have given it from 7½ to 17½ per cent., 10 per cent., therefore, seems a moderate estimate.

There can be no doubt that in no way can good combustion be so thoroughly effected as by regulating the supply of air to the requirements of the fire. Without going into an elaborate analysis it may be said that it is obvious that when a small quantity of coal is burned in a given time that less air is required and a smaller grate is sufficient than is needed when the maximum amount of coal, say 200 lbs. per square foot of grate per hour, is burned. For that reason it is thought that a grate whose size can be adapted to the rate of fuel consumption would produce much more perfect combustion than the present grates do whose size is unalterable; 10 per cent. of saving does not seem extravagant.

The difference which can be effected in operating any locomotive by good men need not be discussed.

It is not clear from the statement which has been made to what cause or causes the superior economy of the new "Northwestern" engine is attributed. It is said that "the coal consumption is about 20 per cent. less than with the standard eight-wheel engines, having smaller boilers and grates," so that the economy or a part of it may be attributed to the size of the boiler and grate.

The saving which can be effected by compounding, whatever it may be, will be due to a totally different cause; that is, to a more economical use of the steam. The economy of heating feed-water is due to the saving of what would otherwise be waste heat. This is also true of superheating, but which not only saves waste heat, but it improves the quality of the steam and its effectiveness for doing work. An adjustable grate on the other hand effects combustion alone, and should cause a given quantity of coal to produce a greater quantity of heat. The Serve tubes, however, act by what might be called frugality, very much as feed-water heaters do; that is, they save heat which without them would be wasted.

A good engineer and fireman may effect a saving in many ways; they may augment the saving by any and all of the causes enumerated, and by others which have not been referred to. The point which it is desired to emphasize is that nearly all these means of economy act in different ways, and on what may be called different functions of a locomotive, so that excepting in those instances which have been mentioned the saving effected by one is quite different from that which would result from the employment of the others. If then some very considerable economies are not possible in locomotives why not? which is the question this article was intended to propound.

M. N. FORNEY.

The protection of boiler tubes by electro-galvanizing is used extensively in England and abroad, the English Admiralty now specifying that all boiler tubes shall be covered externally with a coating of zinc equal to 1¼ oz. per square foot.

80,000-POUND SIDE-DUMP CARS.

For Coal, Ore and Ballast.

Cleveland, Lorain & Wheeling Railway.

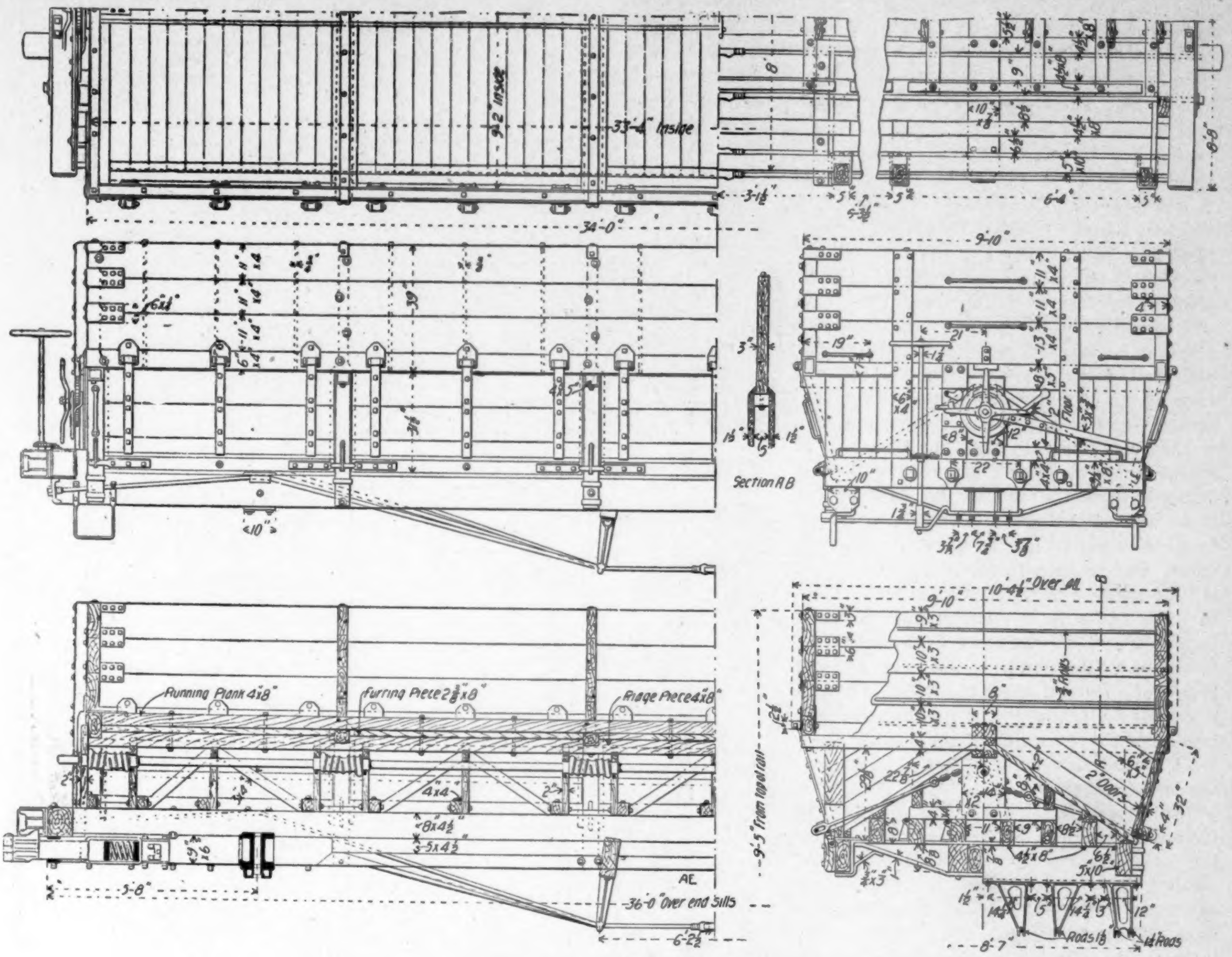
Mr. F. H. Stark, Master Car Builder of the Cleveland, Lorain & Wheeling Railway, has kindly sent us drawings from which 50 side-dump cars of 80,000 lbs. capacity were built for that road six months ago. This road has a heavy coal and ore traffic, the coal going north and the ore south. The cars were designed for this service, and it was considered advisable to make them of the side-dumping type, because for a certain portion of the year they will be used for roadway and track service for hauling gravel for ballasting. This work cannot be as well performed with cars having hopper bottoms. Their weight is increased by this construction, but it was probably considered better to build cars weighing about 41,000 lbs. and use them all the time than to invest so much money in special ballast cars which would not be used for other purposes. These cars have a capacity of 1,450 cubic feet and they carry about 83,000 lbs. of run-of-mine or lump coal when the load is rounded up at the center. The construction provides for carrying most of the load on the side sills. The structure gives substantial support to the floor, as will be seen in the engravings on the opposite page.

The side sills are 5 x 10 in. and the intermediate sills, of which there are six, are 4½ x 8 in., and are placed on top of the bolsters. The box is divided into five separate sections, each about 6 ft. 4 in. long. The floor is supported at the side sills and, at the center of the car, by a 4 x 8 in. ridge piece which rests at the center of each section upon a 2 x 14 in. strut located and supported as shown in the longitudinal and transverse sections. The struts are braced in both directions, fore and aft, and the structure under the floor is continuous for each section. At the spaces between the doors short 5 x 6 in. side stakes are secured to the side sills and upon the tops of these side stakes 4 x 5 in. cross braces rest. These extend across the car and upon them 3-in. partitions are built between the sides of the main body of the box as shown in section at A—B. The other floor supports are shown in the cross section.

The car has 8 truss rods, four of which are at the side sills where they are most needed. These are 1¼ in. rods giving a depth of 27 in. to the trusses. These could not be deeper and clear the floor. The intermediate truss rods are 1¼ in. and give trusses 34 in. deep. In many side-dump cars difficulty has developed in holding the truss rods at the side sills. Mr. Stark has placed substantial forgings over the ends of the side sills in this design to avoid this trouble. The draft timbers are 6 x 9 in. and the twin-spring draft gear standard for this road is placed between them. The doors are operated from the ends of the car. The operating chains and rods are placed in the spaces between the sections, the short posts already referred to, being cut to pass the rods. The doors are all operated simultaneously by a horizontal shaft having at one end a large star wheel with locking devices. The chief dimensions of the car are as follows:

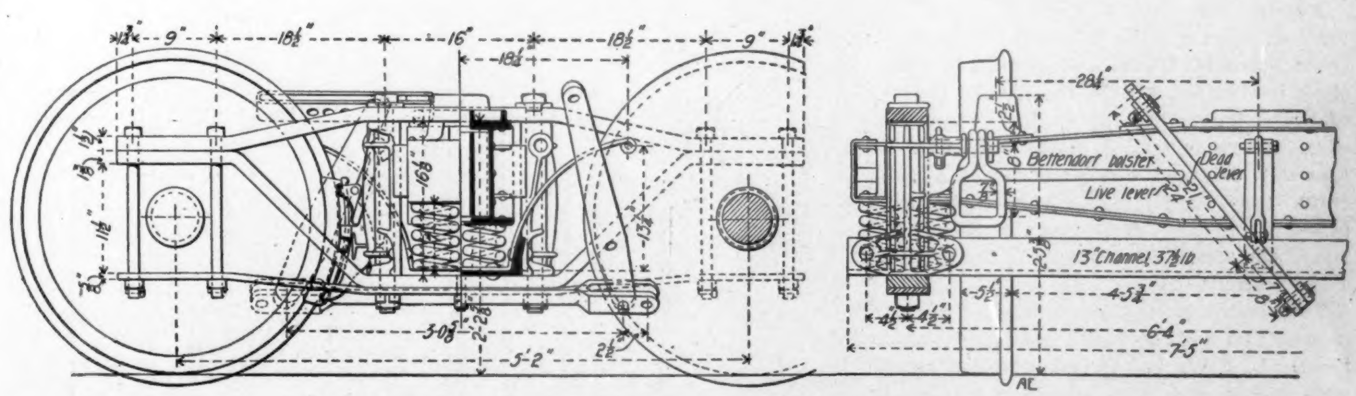
Length over end sills	36 ft.
Length inside	33 ft. 4 in.
Width over side sills	8 ft. 7 in.
Width of bottom at needle beams	8 ft. 7 in.
Width inside at top	9 ft. 2 in.
Height from rail to top of box	9 ft. 5 in.
Weight, empty	41,000 lbs.
Cubic capacity	1,450 cu. ft.
Nominal capacity, coal	80,000 lbs.
Actual capacity, coal	83,000 lbs.
Side sills, section	5 by 10 in.
Intermediate sills, section	4½ by 8 in.
End sills, section	8 by 9 in.

The trucks are the standard, diamond type, used by this road for 40-ton cars. They have Bettendorf bolsters and roller side bearings, the latter were supplied by the Chicago Railway Equipment Co.



80,000-Pound Side Dump Cars.

For Coal, Ore and Ballast—Cleveland, Lorain & Wheeling Railway



Standard Truck for 80,000-Pound Cars—Cleveland, Lorain & Wheeling Railway.

The Manhattan Elevated of New York has officially decided to use the third rail system in changing from steam to electric traction. Two motor cars will be used on each train of six cars, one at each end, and each motor car will have two motors. The work of constructing the enormous power plant at 74th street and East River has been started, and the Allis works in Milwaukee will begin to deliver the machinery early in September. The engine contract is for over $3,000,000. The dimensions of the power house are 425 by 200 ft.

The rapid acceleration as well as high speeds reached by automobiles is somewhat startling. We are told by Prof. Hele-Shaw in a paper before the Institution of Mechanical Engineers (England) of an average speed of 65 miles per hour. He says: "The extraordinary nature of these results lies not so much in the fact of a high speed of 65 miles an hour by a motor vehicle but in the fact that, starting from rest, the average speed for the first kilometer was 46½ miles an hour." He was describing recent motor carriage trials in France.

WIDE FIREBOX 10-WHEEL PASSENGER LOCOMOTIVES.

Delaware, Lackawanna & Western Railroad.

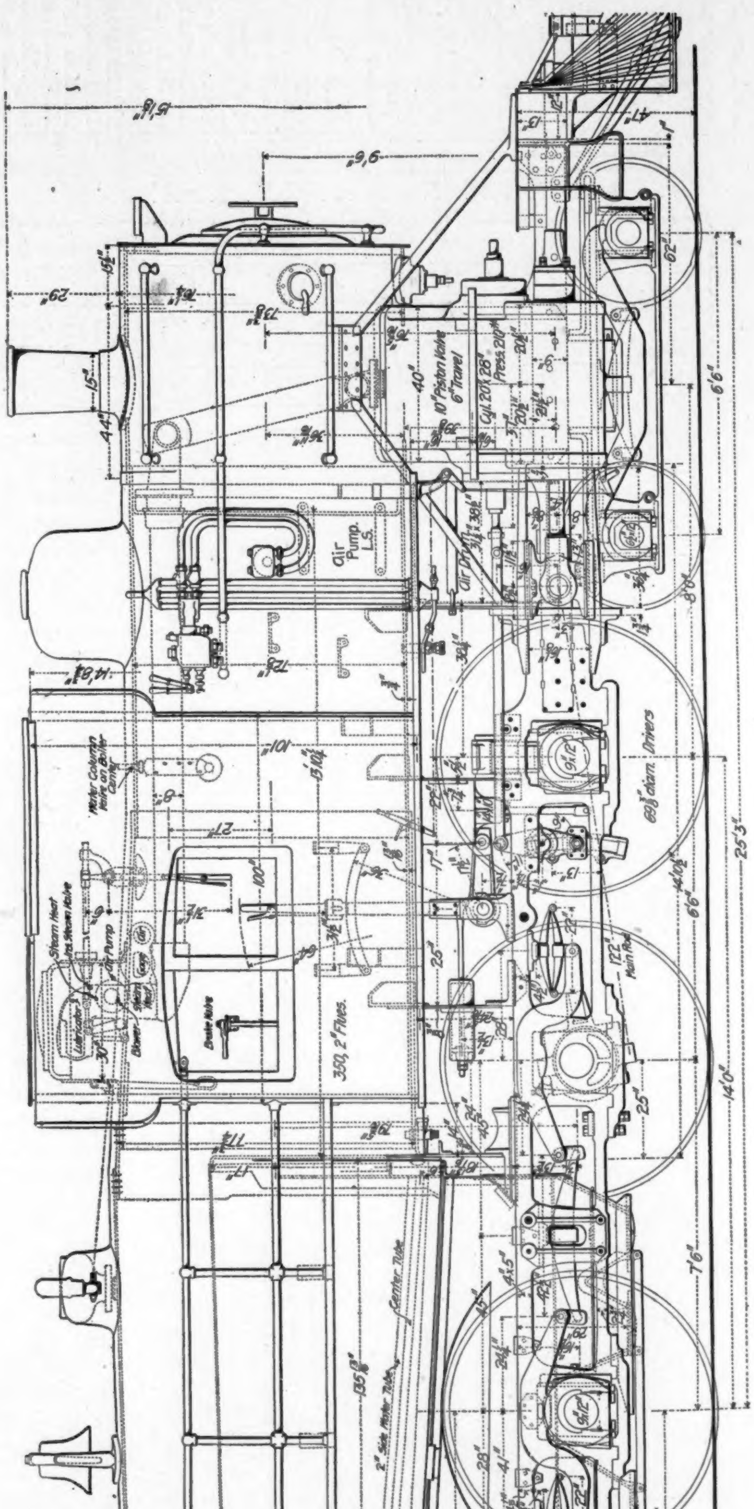
The Heaviest Passenger Locomotives.

The new 10-wheel passenger locomotives recently built by the Brooks Locomotive Works for the Delaware, Lackawanna & Western are the heaviest passenger locomotives ever built. They are powerful and are reported to be giving excellent service. Their greatest interest to us, however, centers in the combination of the 10-wheel type with a firebox having 84.2 sq. ft. of grate area, the diameter of the drivers being 69⅜ in. In view of the difficulties in getting the firebox above the driving wheels the design was worked out very skilfully. The throat is, of course, shallow, and to increase the vertical distance from the fire to the flues at the front end of the grate the tubes were not brought down as low as usual in the tube sheet, the distance from the underside of the lowest flues to the sheet being about 7½ in. The boiler is 72 in. in diameter, which is the largest of which we have record for this type. Its center is the very unusual height of 9 ft. 6 in. above the rails. The firebox sides are straight at the bottom running into easy curves which should prove beneficial to the stay bolts. There is no combustion chamber.

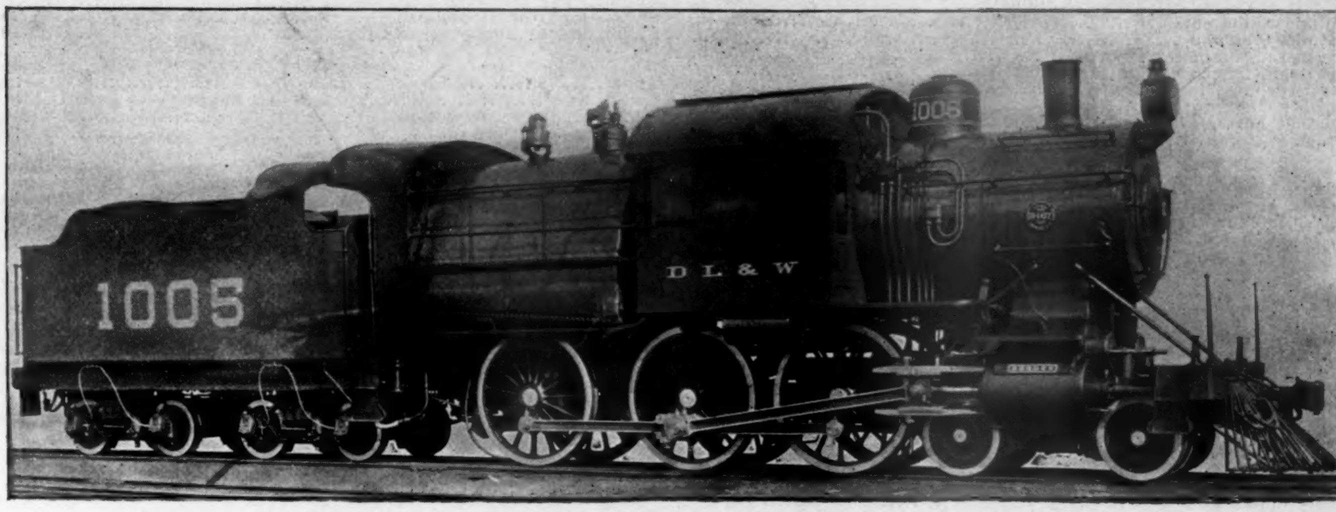
Until the appearance of these engines the Lake Shore engines, of the same type and by the same builders (American Engineer, November, 1899, p. 343), were the heaviest in passenger service. The Lake Shore engines have 217 sq. ft. more heating surface with boilers 6 in. smaller in diameter and 7,400 lbs. less total weight. The D., L. & W. engines probably, however, have an advantage in boiler capacity because of the very large grates.

Among the details the following are noticed: large driving journals, 6½ by 12-in. truck journals, truck brakes, driving brake shoes behind the wheels, the Brooks method of equalizing across the engine at the forward drivers, extended piston rods 4 in. in diameter, enlarged wheel seats for the main crank pins, 10-in. piston valves, diagonal braces from the smokebox to the guide yokes, the steam dome placed in the cab and a short "front end."

This design is considered timely; it is not strange that wide fireboxes should be used on the D., L. & W., but the combination of the wide firebox and 70-in. wheels in a 10-wheel engine is decidedly encouraging to those who would like to use wide grates on heavy passenger engines with bituminous coal. Fine anthracite is used on these engines, but we believe that a similar arrangement with a smaller grate would work out nicely for soft coal. The lack of depth of the firebox under the tubes might be compensated for by additional length. There is much in this design that is suggestive for soft coal burners. The following table supplements the description.



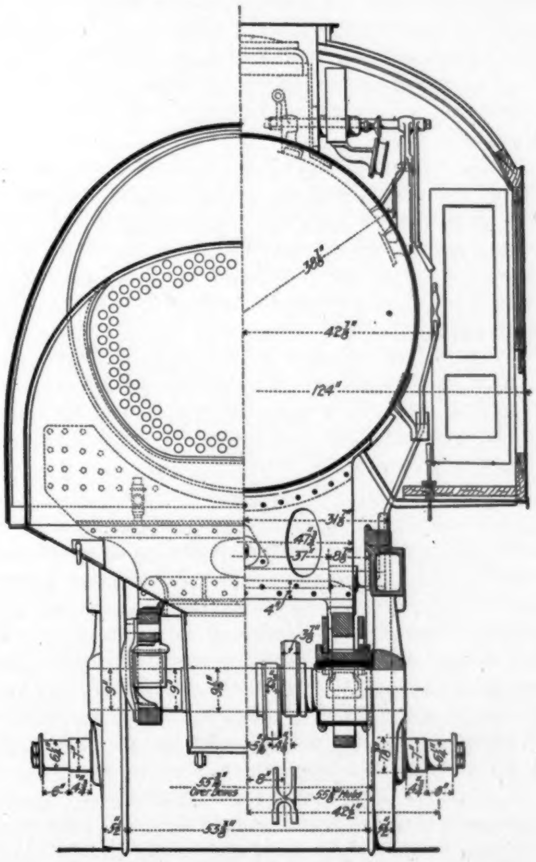
Ten-Wheel Passenger Locomotive—Delaware, Lackawanna & Western Railroad.



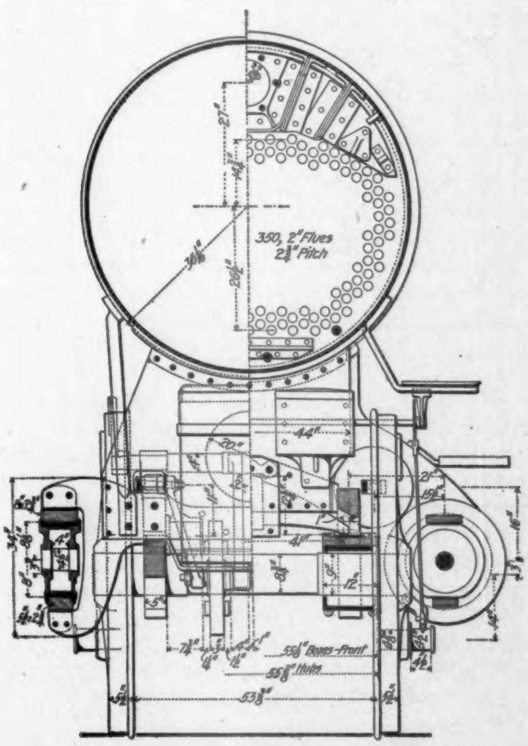
TEN-WHEEL PASSENGER LOCOMOTIVE, WITH WIDE FIREBOX.

DELAWARE, LACKAWANNA & WESTERN R. R. — BROOKS LOCOMOTIVE WORKS, *Builders.*

Weights: Total of engine............179,000 lbs.; on drivers..... 137,000 lbs.; total, engine and tender, 299,000 lbs.
Wheel base: Driving...........14 ft.; total of engine........ 25 ft. 3 in; total, engine and tender............50 ft. 10¼ in.
Cylinders: 20 x 28 in. Wheels: Driving ....69⅝ in; truck ....36 in.; tender............ 33 in.
Boiler: Diameter...........72⅛ in; boiler pressure...... 210 lbs.
Firebox: Length ....127 in.; width ....97 in.; depth, front ...... 61 in.; depth, back............50 in.
rate: Water tube; grate area....... 84 sq. ft.; Tubes: Number 350; diameter.. ... 2 in.; length........13 ft. 10¼ in.
Heating surface. Tubes 2,520 sq. ft.; firebox............180 sq. ft.; total ....2,700 sq. ft.
Tender: Eight-wheel; water capacity............6,000 gals.; coal capacity............12 tons.



Section Through Boiler and Firebox.



Section Through Running Gear.

Ten-Wheel Passenger Locomotive. Delaware, Lackawanna & Western Ry.

Gauge	4 ft. 8½ in.
Kind of fuel to be used	Fine anthracite coal
Weight on drivers	137,000 lbs.
Weight on trucks	42,000 lbs.
Weight, total	179,000 lbs.
Weight tender, loaded	120,000 lbs.

General Dimensions.

Wheel base, total, of engine	25 ft. 3 in.
Wheel base, driving	14 ft. 0 in.
Wheel base, total, engine and tender	50 ft. 10¼ in.
Length over all, engine	38 ft. ¾ in.
Length over all, total, engine and tender	60 ft. 10¾ in.
Height, center of boiler above rails	9 ft. 6 in.
Height of stack above rails	15 ft. 1⅛ in.

Heating surface, firebox	180 sq. ft.
Heating surface, tubes	2,520 sq. ft.
Heating surface, total	2,700 sq. ft.
Grate area	84.2 sq. ft.

Wheels and Journals.

Drivers, diameter	69⅝ in.
Drivers, material of centers	Cast steel
Truck wheels, diameter	36 in.
Journals, driving axle	9 in. by 12 in.
Journals, driving axle wheel fit	9 in.
Journals, truck axle	6½ in. by 12 in.
Journals, truck axle wheel fit	6⅝ in.
Main crank pin, size	6¼ in. by 6 in.
Main coupling pin, size	7 in. by 4¾ in.
Main pin, diameter wheel fit	7⅝ in.

Cylinders.

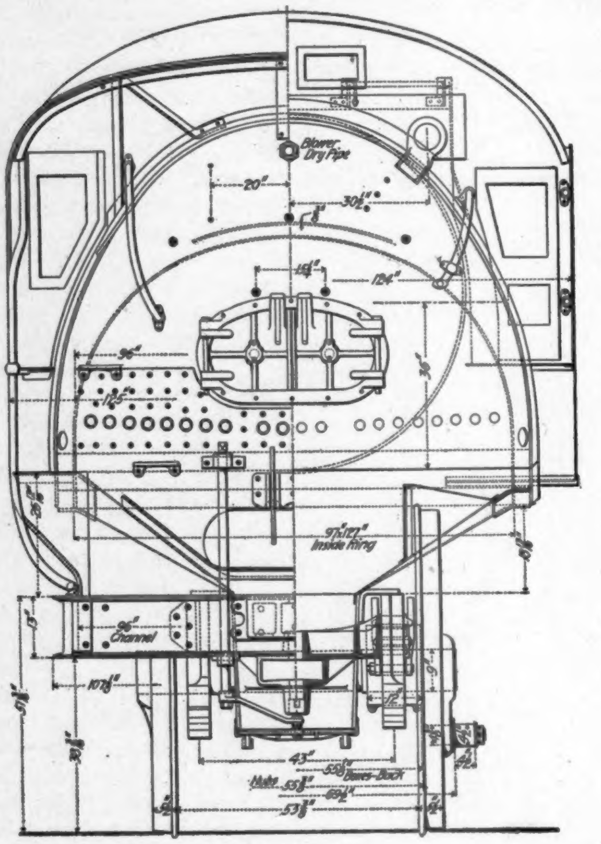
Cylinders, diameter	20 in.
Cylinders, stroke	28 in.
Piston rod, diameter	4 in.
Main rod, length center to center	122 in.
Steam ports, length	20½ in.
Steam ports, width	2 in.
Exhaust ports, least area	75 sq. in.
Bridge, width	3¼ in.

Valves.

Valves, kind of	Improved piston
Valves, greatest travel	6 in.
Valves, steam lap (inside)	1 1/16 in.
Valves, exhaust clearance (outside)	1/16 in.
Lead in full gear	1/16 in. negative

Boiler.

Boiler, type of	Conical connection wagon top
Boiler, working steam pressure	210 lbs.
Boiler, material in barrel	Steel
Boiler, thickness of material in shell	¾ in., 13/16 in., ⅞ in., ⅝ in., 9/16 in.
Boiler, thickness of tube sheet	¾ in.
Boiler, diameter of barrel, front	72⅛ in.
Boiler, diameter of barrel at throat	77¾ in.
Boiler, height at back head	75 in.
Seams, kind of horizontal	Sextuple lap
Seams, kind of circumferential	Triple lap
Crown sheet, stayed with	Radial stays
Dome, diameter inside	30 in.



Rear View.

Firebox.

Firebox, type	Wide, over wheels
Firebox, length	127 in.
Firebox, width	97 in.
Firebox, depth, front	61 in.
Firebox, depth, back	50 in.
Firebox material	Steel
Firebox, thickness of sheets	Crown, ⅜ in.; tube, ⅝ in., side and back, ⅜ in.
Firebox, brick arch	None
Firebox mud ring, width	Back and sides, 3½ in.; front 4 in.
Firebox, water space at top	Back, 4½ in.; front, 4 in.
Grates, kind of	Water tube
Tubes, number of	350
Tubes, material	Charcoal iron
Tubes, outside diameter	2 in.
Tubes, length over tube sheets	13 ft. 10¾ in.

Smokebox.

Smokebox, diameter outside	73⅜ in.
Smokebox, length from flue sheet	68 in.

Other Parts.

Exhaust nozzle	Single
Exhaust nozzle, variable or permanent	Permanent
Exhaust nozzle, diameter	4⅞ in., 5 in., 5¼ in.
Exhaust nozzle, distance of tip below center of boiler	1 13/16 in.
Netting, wire or plate	Plate
Netting, size of mesh or perforation	3/16 in. by 1½ in.
Stack, straight or taper	Steel, taper
Stack, least diameter	14¾ in.
Stack, greatest diameter	16⅝ in.
Stack, height above smokebox	29 in.

Tender.

Type	8-Wheeled
Tank, type	"U" shape, with gravity slide
Tank, capacity for water	6,000 gal.
Tank, capacity for coal	12 tons
Tank, material	Steel
Tank, thickness of sheets	¼ in.
Type of under frame	Brooks 13 in. steel channel
Type of truck	Brooks 100,000 lbs.
Type of springs	Triplicate elliptic
Diameter of wheels	33 in.
Diameter and length of journals	5 in. by 9 in.
Distance between centers of journals	5 ft. 5 in.
Diameter of wheel fit on axle	6⅜ in.
Diameter of center of axle	5⅝ in.
Length of tender over bumper beams	21 ft. 0 in.
Length of tank, inside	19 ft. 6 in.
Width of tank, inside	10 ft. 0 in.
Height of tank, not including collar	60 in.
Type of draw gear	M. C. B. Gould

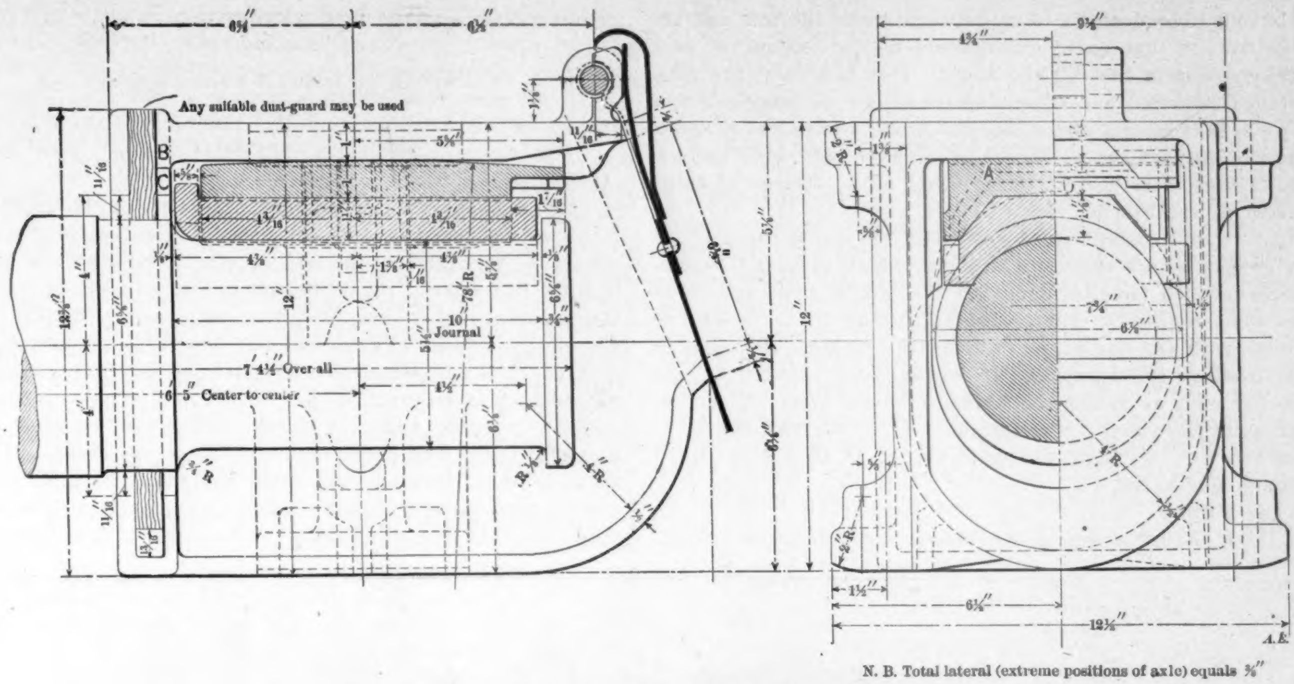
M. C. B. BRAKE SHOE TESTS.

At the last convention of the M. C. B. Association the standing committee on tests of brake shoes was instructed to test such brake shoes which have made sufficient departure from those previously tested to affect their efficiency or durability, as should be presented to it by railway companies who are members of the Association, the committee to indicate such times during the year as it intends to make these tests.

The committee will make tests of brake shoes during the month of March, 1901, and if it is the desire of the railroads represented in the Association to have brake shoes tested, they should communicate with the chairman of the committee as early as possible, so that arrangements can be made for the tests. Communications should be addressed to Mr. S. P. Bush, Superintendent of Motive Power, C., M. & St. P. Ry., West Milwaukee, Wis.

The form of packing for piston valves has been studied by many able men with a view of using wide rings to secure good wearing areas, and at the same time prevent steam pressure from getting under the rings and forcing them out against the bushings, causing excessive frictional resistance. The report of the Master Mechanics' Association committee on piston valves (see page 267 of our August number) closes with the following positive expression: "The committee finds a great variety of packing used for piston valves. It can be said, however, with perfect certainty, that plain snap packing rings will give entirely satisfactory service."

The work on the new shops of the Chicago & Northwestern, at Chicago, which was delayed somewhat this spring on account of labor troubles, has since resumed an active appearance and the enlarged plant will probably be ready for operation by the first of November. The two new buildings of the car department are finished and the three new buildings and an addition to the tank shop of the locomotive department are nearly ready. The boiler shop, which is to take care of the repairs on 1,185 locomotives, is being equipped with its machinery. The cranes are up and the electrical installation completed. The tank shop, which is being lengthened 144 feet, and the walls raised to a height of about 25 feet, will require several weeks for completion. This shop, as stated in the general description of these improvements which appeared in the April issue of this paper, page 109, has received unusual attention and will be a very well arranged department. The two buildings requiring the greatest amount of interior work are the power house and machine shop annex. The floors of this annex are receiving the finishing touches prior to the placing of machines. In the power house the boilers have all had fires under them and the engines, generators, compressor and pumps are all in place, but with the exception of the steel work the floors are not laid. There will be a necessary delay in the completion of these floors as they are to be of tile and cannot be laid to advantage until all of the piping is in place.



A Criticism on the Proposed 5½ by 10 M. C. B. Journal Box.

THE PROPOSED 5½ BY 10 M. C. B. JOURNAL BOX.

By F. M. Whyte.

Mechanical Engineer New York Central & Hudson River Railroad.

When the report of the committee of the Master Car Builders' Association, appointed to recommend a journal box suitable for a 5½ by 10-in. journal, was opened for discussion at the Saratoga convention, question was raised concerning some of the dimensions and also concerning the gages; the objections were not presented clearly and probably, therefore, were not understood. The criticisms seem of sufficient importance to justify calling attention to them again.

The criticism on the box is that provision has not been made for sufficient clearance between the inside end of the bearing and the back wall of the box. With every part in its normal position, the end of the bearing is ⅛ in. away from the back wall of the box, but as there is, in the same normal position, 1/16 in. between the lug on the bearing and the lug on the box there is only 1/16 in. clearance between the end of the bearing and the back wall of the box when the lugs on the bearing and those on the box are in contact. This 1/16-in. clearance is ample, but with rough castings, and not gaged, for the box and bearing this amount is not insured if the dimensions and design presented by the committee are followed. The clearance is the same as allowed in the smaller M. C. B. boxes and it might be reasoned that no more is needed in the 5½ by 10 box, but the error may be in not considering the difference in the loads carried, and that the opening in the 3¾ by 7 box is larger than the end of the bearing; it is possible that if the smaller bearings strike the walls of the boxes in which they are placed the blow is not sufficient to break the box. It is certain, however, that the back walls of 5 by 9 and of 5½ by 10 boxes have been broken in considerable numbers, and in every case with which we are familiar every appearance would indicate that the end of the bearing struck the wall before the lugs on the bearing and box engaged.

A criticism without suggesting a correction would be hardly justifiable and therefore a correction is offered. It is appreciated that a change in the axle, by increasing its length at least, is not to be considered, also that neither the dust guard space nor the thickness of the inner and outer walls should be decreased, there remains, therefore, only the alternative of cutting out such part of the inner wall as can be. in the present design, struck by the bearing. This can be accomplished by changing the box as would be indicated by substituting the line A, in the cross-section of the accompanying engraving, for the line D, and the line B, in the longitudinal section, for the line C. This change would not affect the strength of the box materially. These drawings are reproduced from the report.

The same change could be made advantageously in the 4¼ by 8 and the 5 by 9 boxes.

Standard gages have been provided for the bearing, but if more clearance is not allowed between the end of the bearing and the back wall of the box for the three largest boxes, then the gages for the bearings are not as complete as they should be, inasmuch as there is no gage for the distance from the face of the lug to the outer face of the collar. A gage is provided for the distance from the face of the lug to the inside face of the collar, but the bearing may pass this gage and all of the other gages and the collar be of such thickness as to allow the bearing to strike the back wall of the box before the lugs on the bearing and box engage, even though the box is made exactly to dimensions. If the boxes are cut out in the back wall so that they cannot foul the bearings the present gages for the bearings are sufficiently complete.

While referring to gages it may be profitable to urge the necessity of adopting suitable gages for the boxes; such gages will necessarily be complicated, but they are certainly needed. The relation of the inside lugs to each other and to the holes for the box bolts or the pedestal flanges and the angle which the holes on the pedestal flanges and the sides of the box make with the key-bearing face should be covered. Some boxes are made from patterns and core-boxes parted in a vertical plane which includes the longitudinal axis, and the possibility of producing twisted castings from such patterns is the extreme.

Proofs of Mr. Whyte's criticism were sent to several railroad officers, and the following replies have been received:

To the Editor:

I have read Mr. F. M. Whyte's criticism on the proposed 5½ by 10-in. journal box. As Mr. Whyte acknowledges in his remarks, the box, if perfectly made, has sufficient clearance between the bearing and back of box at all times, or in other words, it is impossible to get the end of the bearing nearer than

to have a clearance of 1/16 in. between it and the box, and the only trouble that could arise would be on account of poor workmanship in making the boxes. This is a point the committee considered and concluded that, like all other parts of the box that have a direct bearing on the wedge and brass, it was the duty of the purchaser to see that they were correct, and if they were correct there would be no danger of being broken by the bearing.

In further comment on the criticism the committee brought the subject before the users of some twenty thousand 100,000-lb. cars, which included about all the cars of this capacity in use. The replies, without exception, indicated there was no trouble with the box in use, which has the same clearance as submitted on the drawings. It was therefore decided to submit the plan as shown, believing it would meet all the requiremnts for which it was designed.

W. GARSTANG,
Supt. Motive Power, C., C., C. & St. L. Ry.

Indianapolis, Ind.
To the Editor:

I think the criticisms of Mr. Whyte are well taken. While it is true that there is sufficient clearance if the castings are perfect, it is almost impossible to get perfect rough castings. A clearance of 1/16 in. in rough castings is insufficient.

I have, however, obviated this difficulty in a box made here by making the back wall 3/32 in. thinner and making the box of malleable iron instead of gray iron.

There is another way to accomplish the same result, and I believe it would be preferable, and that is to set back the outside face of the hub of the wheel ⅛ in. and add this to the inside of the hub; then make the box ⅛ in. longer than is now shown.

"CAR BUILDER."

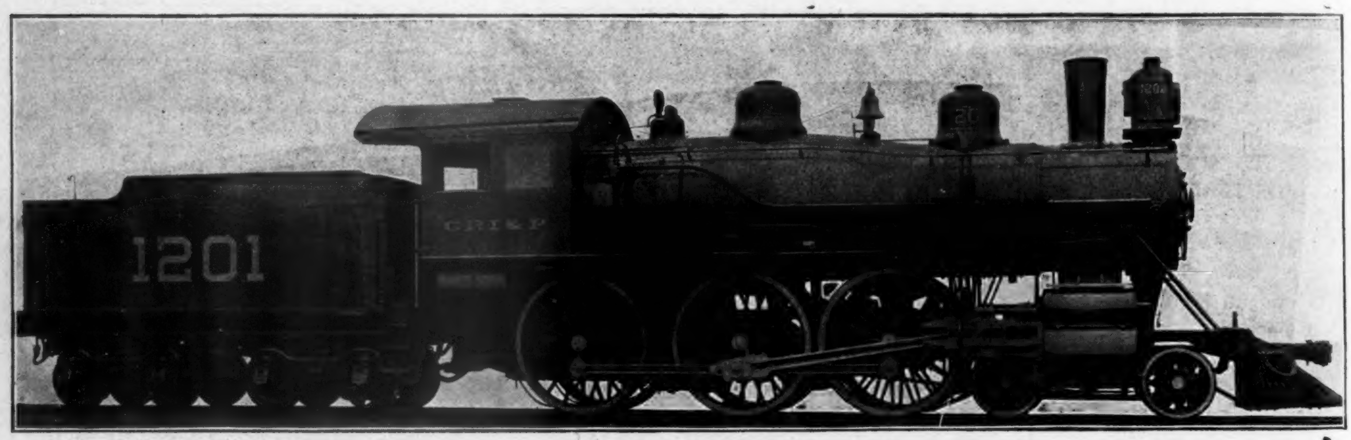
TEN-WHEEL PASSENGER AND FREIGHT LOCOMOTIVES.

Chicago, Rock Island & Pacific Railway.

Vauclain Compound Type.

This road has been exceedingly conservative on the compound locomotive question, and the interest in these locomotives centers in the fact that the increase in weight and speeds of trains resulted in a trial of the compound as a relief measure because the endurance of firemen had been very nearly reached with the simple engine. There was also a desire to economize in fuel, but it is understood that the fast and heavy trains necessitated such large capacity in a simple engine as to render it difficult to supply sufficient steam. When adopted after such a careful policy and under such conditions, the compound has an exceedingly favorable opportunity to show what it can do, and we are informed that the firemen are greatly pleased with them and that they are known to be saving coal, although no extravagant claims are made. Mr. Wilson appeared to our representative to be enthusiastic about them.

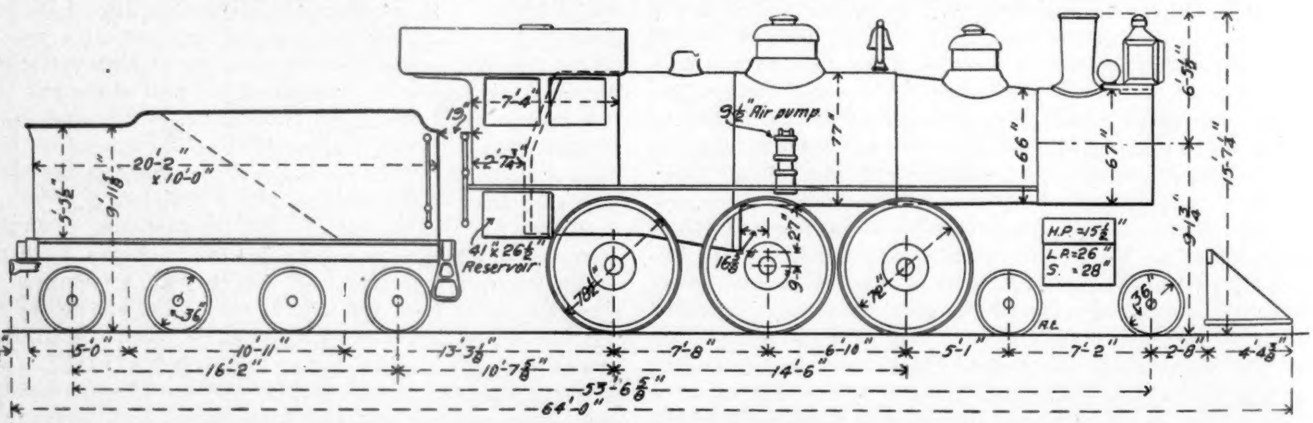
The passenger service of this road includes fast trains of 12 cars, with a total weight of 1,103,000 lbs. While the large eight-wheel engines used in the same service were able to handle these trains on schedule, it was not easy to make up time, and the weights of the trains could not be reduced. Two Vauclain passenger engines were ordered and these did such good work that three more were ordered, and also three freight engines, making a total of 17 freight and 5 passenger engines.



TEN-WHEEL VAUCLAIN COMPOUND PASSENGER LOCOMOTIVE.

CHICAGO, ROCK ISLAND & PACIFIC RAILWAY. BALDWIN LOCOMOTIVE WORKS, Builders.

Weights: Total of engine............179,295 lbs.; on drivers............134,560 lbs.; total engine and tender......... 289.000 lbs.
Wheel base: Driving........14 ft. 6 in.; total of engine........ 26 ft. 9 in.; total engine and tender............53 ft. 6 in.
Cylinders: 15½ and 26x28 in. Wheels: Driving.... ......78½ in.; truck.... 36 in.
Firebox: Length............118 in.; width............40⅛ in.; depth front.... .. ....79⅛ in.; width, back. ....67 in.
Grate: Area.... .. 32.8 sq. ft. Tubes: Number . ....329; diameter .... 2 in.; length.... 15 ft.
Heating surface: Tubes........... 2,569 sq. ft.; firebox..........180.5 sq. ft.; total ....2,750 sq. ft.
Tender: eight-wheel.; Tank capacity............5,500 gals.; coal.... ......10 tons.



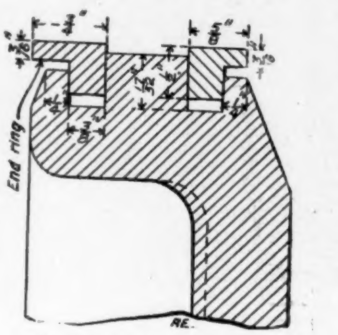
Outline Diagram of Ten-Wheel Locomotives—Chicago, Rock Island & Pacific Railway.

These freight engines are of the same type and dimensions, except as to the wheels and weights. The passenger engines have 78 in. drivers and 36 in. engine truck wheels and the freight have 57¾ in. drivers and 30 in. truck wheels. The weights are as follows:

	Total.	On drivers.	On trucks.
Passenger	179,275 lbs.	134,560 lbs.	44,715 lbs.
Freight	173,015 lbs.	130,150 lbs.	42,865 lbs.

The small diagram shows the sloping form of the back boiler head. The effect of this practice, which has been in successful use on other roads, notably the Pennsylvania, is to lighten the back end of the engine, give more room in the cab and render the firebox heating surface more effective. The flames appear to follow the back sheet closely, and Mr. Wilson has noted an increase in the temperature of the cab over that of the usual construction, which will necessitate lagging the back head. This seems to be excellent evidence of improved circulation at the back end of the firebox.

Considerable thought and care have been put into the cab arrangement and the tender hand-holds and steps, with a view of increasing the safety and comfort of the men. The lighting of the engine is by electricity, from curent furnished by a steam turbine located back of the headlight on the smokebox. Lights are placed under the running board for the benefit of the engineer in oiling and inspecting the machinery. It has been found necessary on this road to guard against the setting of fires by sparks from the ash pans, on account of the peculiar behavior of some of the coals used. This has led to the use of double dampers at both ends of the ash pans, one of the usual plate construction and the other of wire netting. We also show a section through the packing rings of the piston valves to illustrate the overhanging cut-off edges. The chief dimensions are given in the following table received through the courtesy of the builders:



Piston Packing Rings.

Passenger and Freight Locomotives, Chicago, Rock Island & Pacific Ry.

Cylinders.	
Diameter (high pressure)	15½ in.
Diameter (low pressure)	26 in.
Stroke	28 in.
Valve	Balanced piston

Boiler.	
Diameter	66 in.
Thickness of sheets	11/16 in. and ¾ in.
Working pressure	200 lbs.
Fuel	Soft coal

Firebox.	
Material	Steel
Length	118 in.
Width	40⅛ in.
Depth	79½ in. front; 67 in. back
Thickness of sheets	Sides, 5/16 in.; back, ⅜ in.; crown, ⅜ in.; tube, ⅝ in.

Tubes.	
Number	329
Diameter	2 in.
Length	15 ft. 0 in.

Heating Surface.	
Firebox	180.5 sq. ft.
Tubes	2,569.6 sq. ft.
Total	2,750.1 sq. ft.
Grate area	32.8 sq. ft.

Driving Wheels.	
Diameter (outside)	78½ in. passenger; 64¾ in. freight
Diameter of center	72 in. passenger; 57¾ in. freight
Journals	9 in. by 12 in.

Engine Truck Wheels.	
Diameter	36 in. passenger; 30 in. freight
Journals	6½ in. by 11 in.

Wheel Base.	
Driving	14 ft. 6 in.
Rigid	14 ft. 6 in.
Total engine	26 ft. 9 in.
Total engine and tender	53 ft. 6⅝ in.

Weight.	
On drivers	Passenger, 134,560 lbs.; freight, 130,150 lbs.
On truck	Passenger, 44,715 lbs.; freight, 42,865 lbs.
Total engine	Passenger, 179,275 lbs.; freight, 173,015 lbs.

Tender.	
Diameter of wheels	36 in. passenger; 33 in. freight
Journals	5 in. by 9 in.
Tank capacity	5,500 gal.

A REMARKABLE IMPROVEMENT IN TOOL STEEL.

For several years it has been rumored that remarkable success was being attained by a new process of hardening tool steel, developed by Mr. F. W. Taylor and Mr. Maunsel White, of Bethlehem, Pa. Recently a representative of this journal saw some samples of enormously heavy chips removed by a tool hardened by this process, the chips being of a brilliant blue color, indicating that they were removed at an exceedingly high temperature, and we are now informed that soft steel is being cut at the previously unheard of speed of 150 ft. per minute. At the Saratoga Conventions Mr. H. F. J. Porter kindly showed our representative samples of chips, which were tagged as follows:

Quality of Steel.	Width of Cut.	Depth of Cut.	Speed in Feet per Minute
.60 carbon.	⅝ to ⅞ in.	7-32	29 ft.
.40 "	3-16 "	1-16	60 ft.
.10 "	3-16 "	1-16	150 ft.
1.05 tool steel.	3-16 "	1-16	15 ft.

This hardening process was developed at the works of the Bethlehem Steel Company in connection with a comprehensive plan carried out by Mr. Taylor for increasing the capacity and improving the operation of the plant. The machine shop at Bethlehem, which is the largest in the country, was six months behind the forge and an increase of capacity by increase of equipment was prohibited by the expense. Finding that a large number of different kinds of tool steel were in use by different workmen on similar work, Mr. Taylor spent a great deal of time in studying the question of tool steel, with the final result of developing this new process and discarding steel made by the others. This process is applied after the tool is forged, and the remarkable property, whereby the hardness of the steel is retained even when heated by the friction of its work up to the point of redness, explains the wonderful results. The penetration of the hardening effect is sufficient to reach the center of a tool 4 in. square, and the interior is put into the same condition as the outside, the result being that a tool made of this steel is good until completely worn out. The method of hardening gives extremely uniform results and it improves the forging qualities. It is understood that the process may be applied to all the standard brands of self-hardening steel and that they are all improved to different degrees by the treatment. The best results, however, are obtained from a specially prepared steel. It is also stated that this special steel can be annealed so that it may be machined into shape for twist drills and inserted cutters.

The Bethlehem Steel Company have revolutionized their practice by this improvement. The old machine tools were found inadequate to carry the cuts which the cutting tools themselves would stand, and it has been necessary to take up a general revision of the shop tools. The main shafting has been speeded up from 90 to 250 revolutions and the general improvement and the possibilities elsewhere are shown in the following table:

Average.	October 15, 1898.	May 11, 1899.	January 15, 1890.	Gain in per cent. cut of third over second.	Gain in per cent. cut of third over first.
Cutting speed	8 ft. 11 in.	21 ft. 9 in.	25 ft. 3 in.	16	183
Depth of cut	0.23 in.	0.278 in.	0.30 in.	8	30
Feed	0.07 in.	0.0657 in.	0.087 in.	32	24
Pounds of metal removed per hour	31.18	81.52	137.3	68	340

Recently an exhibition of the working of the steel was given at the Bethlehem works, and the results are sufficiently remarkable to warrant personal investigation by all whom the use of this improvement would affect.

AUTOMATIC ASH ELEVATOR.

Operated by Pneumatic Power.

Chicago & Northwestern Railway.

Altogether the best arrangement we have seen for handling locomotive ashes and cinders has been designed and built by the Motive Power Department of the Chicago & Northwestern for its various round-houses, two having been recently installed at the new roundhouse at Clinton, Iowa, which is one of its most important division points. At terminals it is necessary to take advantage of every means for "turning" engines as quickly as possible in order to save delay to traffic. This is specially important in busy seasons like the present, and many improvements may be expected in coal and ash handling appliances. These are usually the "slowest" parts of terminal equipments.

The apparatus which we are permitted to illustrate was designed by Mr. G. R. Henderson, Assistant Superintendent of Motive Power, under the direction of his superior, Mr. Robert Quayle. It was arranged with a view of facilitating the handling of ashes and cinders, cheapen these operations, do it with simple apparatus and permit of operating the devices in a way which should not cause a moment's delay to the engine while the ashes are being taken away. This hoist transfers the ashes from the ash pan of the engines directly to the cinder cars without intermediate handling. It is handled by a single operator who does not leave the pit.

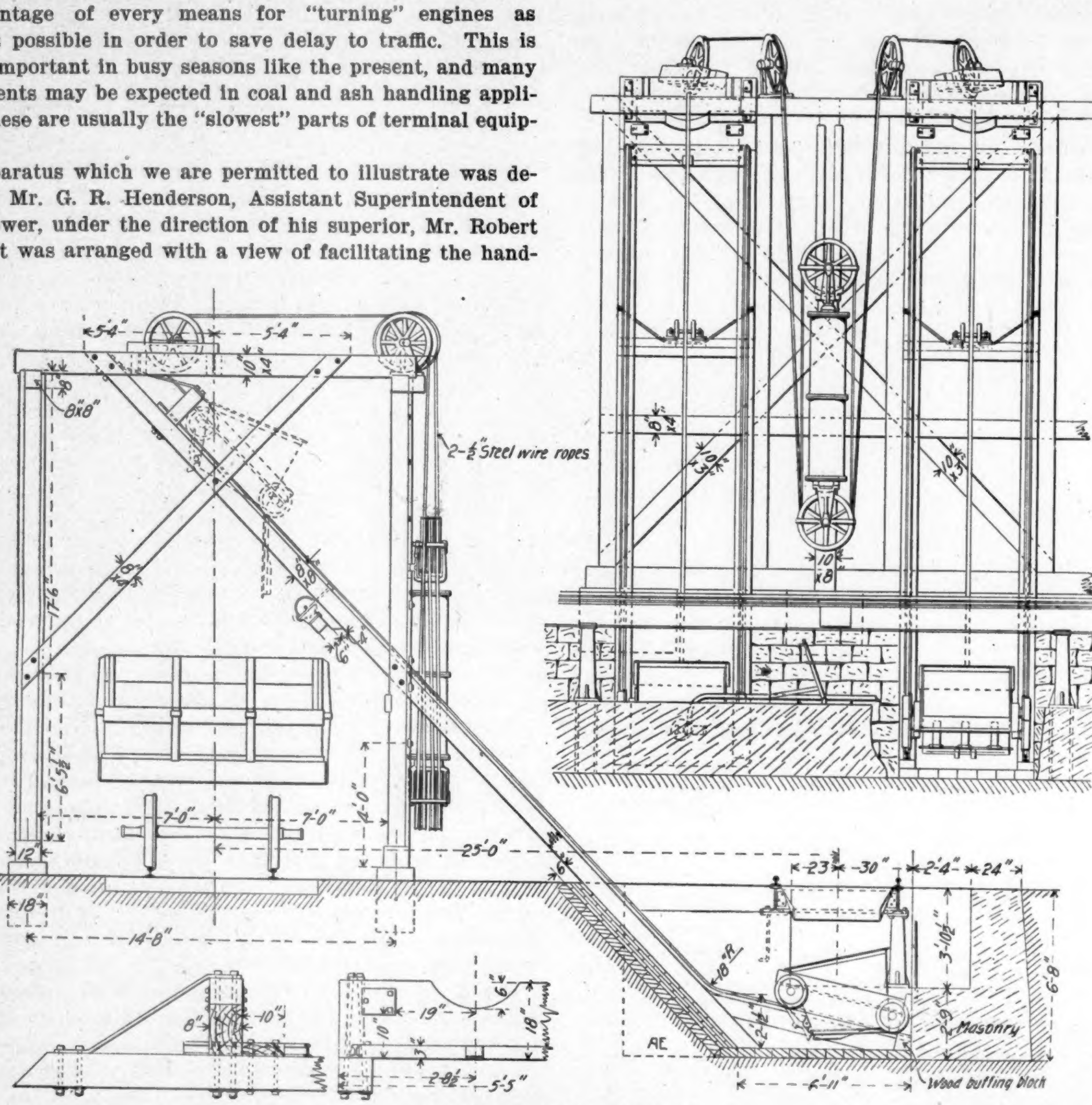


Fig. 1.—General Plan of Hoist.

The essentials of the apparatus are shown in Fig. 1, the plan and sections of the pit in Fig. 2 and the arrangement of the cylinder and automatic controlling devices in Fig. 3.

The pit is 57 ft. long and of the form shown in Figs. 1 and 2. The loading track is 25 ft. from the center of the pit track and level with it. Over the loading track is a substantial frame of timbers supporting the upper ends of the inclined tracks for the pit buckets. At the lower side of the pit, Fig. 2, is a passage the entire length of the pit, in which are located conveniently for the operator, the three-way valves and locking levers.

When an engine has passed over the pit the two ends of the ash pan correspond with the positions of the small trolleys. After the fire has been cleaned and the ashes and clinkers swept out into the trolleys the three-way cock is opened by the attendant and one of the trolleys is drawn up the incline by the pneumatic cylinder and wire rope, and when it comes into contact with the block at the upper end of the track the bottom is automatically tripped and the ashes dropped into the car. The three-way cock is then reversed and the bucket returned to its original position. The door closes as it passes down the inclined track. A lever, shown in Fig. 2, is then moved by the attendant, locking the first bucket and releasing the second. A repetition of the operation of the three-way cock then raises and dumps the second bucket.

This plan employs but one cylinder for two buckets, one bucket being used as an anchor, while the other is emptied. The hoist is made double so that the front end and ash pan may be cleaned simultaneously and with the engines heading in either direction. The attendant does not leave the pit, and while the ashes are being dumped the engine may be moved off the pit and another take its place.

Several of the details are worthy of notice, especially the one with the small wheels on the lower side of the trolley track. This closes the door on its descent, the wheels being

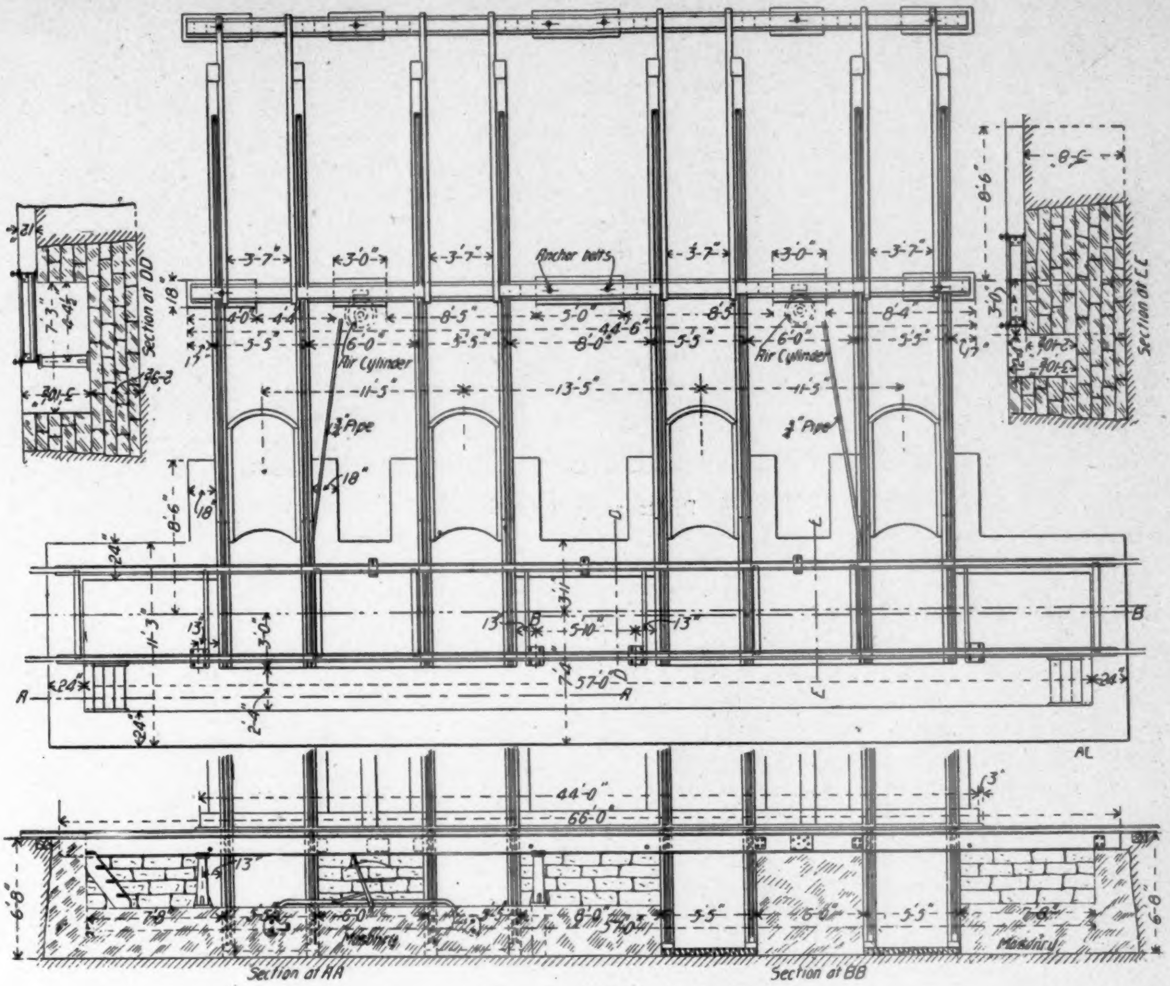


Fig. 2.—Plan of Pit and Frame.

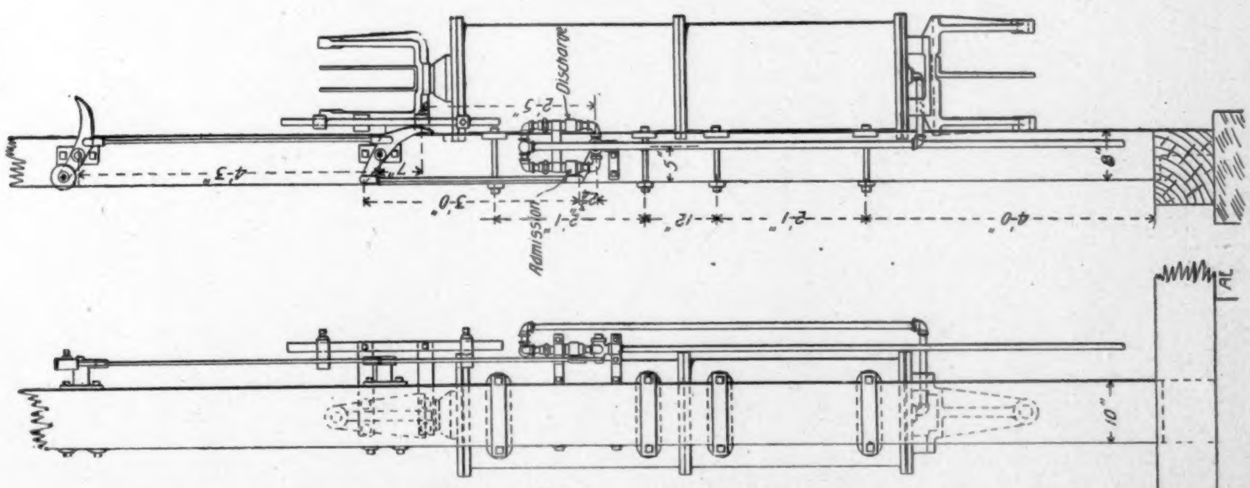


Fig. 3.—Cylinder and Automatic Valves.

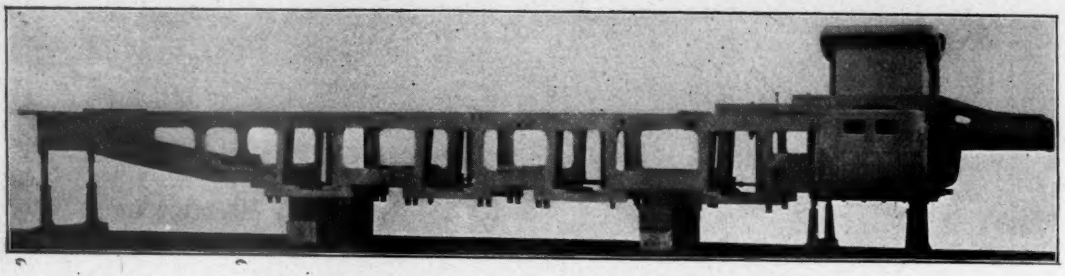
arranged so that when struck by the trolley in its upward trip they move out of the way and clear the door without lifting the car. On the descent the door strikes the wheels and it is closed and latched before reaching the pit. Another ingenious feature is the arrangement for controlling the motion of the trolley, preventing it from striking hard at either end of its travel. The three-way cock, at the cylinder in Fig. 3, is actuated by the motion of the piston. When near the end of its stroke it closes the valve opening in the direction in which the air is moving and compels the remainder of the supply to pass through a small hole in the check valve which opens in the opposite direction. In this way the trolley will be brought to the end of its travels gently, even when the bucket is taken up empty. The other details and the construction of the framing and the rigging of the wire rope are plainly shown in the illustrations.

Two of these hoists have been installed at Clinton, Iowa, and the first night, with the men unaccustomed to the apparatus, forty locomotives were cleaned between six o'clock p. m. and seven o'clock the next morning.

WIGHTMAN'S CYLINDER AND FRAME FASTENING.

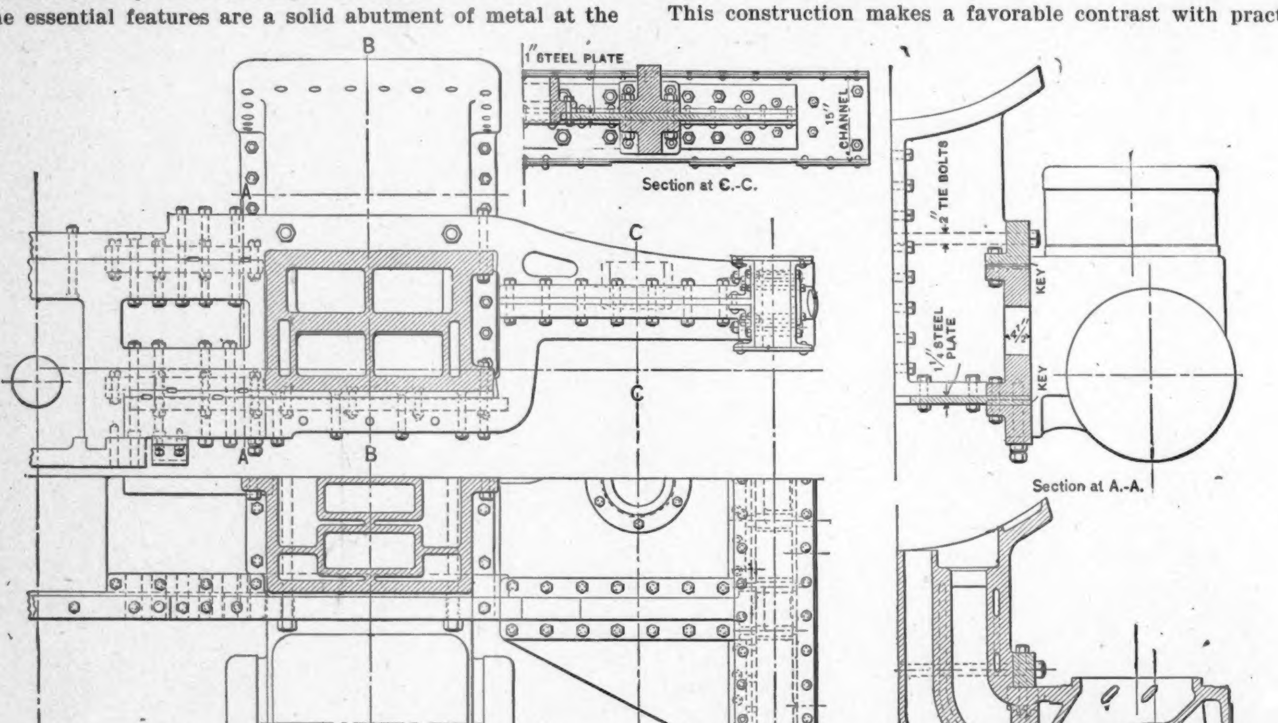
Used by Pittsburgh Locomotive Works on Large Pittsburgh, Bessemer & Lake Erie Locomotives.

To secure sufficient strength of the attachments of cylinders and frames of very large engines has been a difficult problem. The stresses from 24-in. pistons with a boiler pressure of 200 lbs. are enormous, necessitating more careful construction at the front end than has been necessary before. The large engines built by the Pittsburgh Locomotive Works for the Pittsburgh, Bessemer & Lake Erie Railroad, illustrated in our July number, page 214, have a new and very substantial structure between the cylinders and frames and one which we think is stronger and more rigid than any other arrangement we have seen. It was designed especially for these engines and patented by Mr. D. A. Wightman, general manager of the works. The construction is clearly shown in the accompanying engravings which were made from drawings prepared especially for illustration by the Pittsburgh Locomotive Works.



Photograph of Frames With Cylinders Attached.

The essential features are a solid abutment of metal at the back end of the cylinder casting, continuous frame support without splices up to the cylinder, large plates across the engine from frame to frame under and back of the cylinders and also in front of them. These plates are one inch thick. One of them reaches from a point even with the front end of the saddle to the first driving box jaw, extending across the engine from frame to frame and securely bolted between the saddle and the frames. This plate is cut out behind the saddle for the front truck equalizer. The other plate secures the frames in front of the saddle and forms the front deck. The front rails are spliced to the main frames back of the saddle. They come together again in front of it and the front plate forms a solid deck and transverse stiffening structure in front of the saddle. It also carries the truck thimble and is secured to the bumper by angles. The engravings show the method of securing the various parts and the sectional views show the angle forms of the frames for giving good bearing area for the bolts. This construction illustrates an advantage possessed by cast steel for such heavy work. These angle forms might be made in forgings but they would be very expensive. Readers will probably notice the heavy tie rods between the upper bars of the frames through the saddle and also the large number of bolts through the splicer and plates.



Wightman's Cylinder and Frame Fastening.

This construction makes a favorable contrast with practice on some large engines recently built in which the usual form of frames used for much lighter engines has been followed. This plan by Mr. Wightman seems to provide for the large stresses in an admirable way, bringing the resistances to the center of the frame structure and avoiding the usual methods by which the frame splices are subjected to all of the cylinder stresses whether compressive or tensile. With 24-inch cylinders and a pressure of 160 lbs. on the piston from 200 lbs. boiler pressure

the stress on each side will amount to 72,000 lbs. It is evident that a substantial structure is needed to hold up against such work, especially when the stresses will often amount to rapid blows in opposite directions when the engine is slipping. This is believed to be an important and valuable improvement.

ADVANTAGES OF CARS OF LARGE CAPACITY.

Mr. L. F. Loree, General Manager of the Pennsylvania Lines West of Pittsburg, recently presented a valuable report to the International Railway Congress upon the subject of the capacities of freight cars. It appears in the Bulletin of the International Railway Congress, May, 1900, page 941, and in addition to the author's discussion it contains in the form of appendices the most complete record of the dimensions of freight refrigerator and express cars that we have seen. For example, the leading dimensions and weights of 600,000-lb. box cars on 40 different American railroads are given and dimensions of other cars in proportion.

After a review of the development of the present large cars in this country the author takes up the comparative merits of 60,000 and 80,000 lbs. capacity box cars. The following is reproduced from the report and contains an argument by Mr. T. N. Ely, Chief of Motive Power of the Pennsylvania Railroad.

The following table shows the relative weight, capacities and cost of 60,000 and 80,000 lbs. capacity box cars, of which a large number are now being built by the Pennsylvania, Illinois Central and other lines:

Marked Capacity.	Length.	Paying load.	Weight of Body.	Weight of Trucks.	Total Weight.	Lbs. paying load to each lb. dead load.	Cost of car.	Cost per ton of carrying capacity.
60,000	34 ft.	66,000	19,920	12,280	32,200	2.05	$556.35	$16.86
80,000	34 ft.	88,000	20,506	14,694	35,200	2.50	603.95	13.73
Differences.								
20,000	......	22,000	586	2,414	3,000	0.45	$47.60	$3.13

This shows a difference of $47.60 in the cost of the two cars, but the 80,000 lbs. car costs 18.6 per cent. less per pound of carrying capacity than the smaller one.

It is objected that the greater light weight means greater cost of moving the car, but if we analyze the cost of moving the 3,000 lbs. greater weight we have:

Average mileage, box cars per year..........................10,000 miles
Average weight, box cars..16 tons
Average paying load..10 tons
Average cost of transporting paying load per ton-mile........4 mills
Cost of moving car and load per mile............................40 mills
40 mills divided by 26 gives............................1.54 mills per ton
1½ tons additional dead weight carried 10,000 miles...15,000 ton-miles
15,000 ton-miles × 1.54 mills = $23.10, cost per year to haul the additional dead weight.

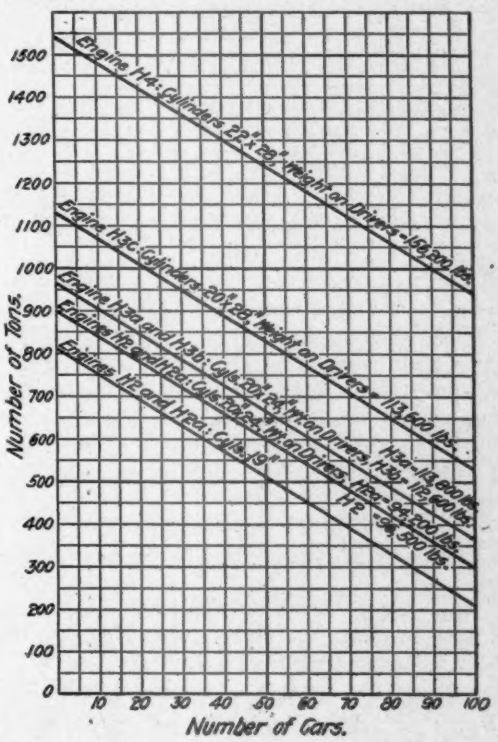
If we assume an average receipt per ton mile of 5.36 mills and the cost as above at 1.54 mills, the net revenue from any additional freight handled in such a car would be 3.82 mills per ton mile, and to pay for the extra cost of moving the extra dead weight we must carry 6,000 tons of paying load, $23.10 = 3.83 mills, and as an 80,000 lbs. car will load at least seven tons more than a 60,000 lbs. car one trip of 857 miles (6,000 ÷ 7) each year, with additional load, would compensate for hauling the extra dead weight of 1½ tons the entire year. (This we understand to be Mr. Ely's argument.—Editor.)

As a matter of fact, these cars can be and have been loaded with 88,000 lbs. of grain at the elevators on the Mississippi River and carried to Baltimore, Philadelphia and New York; the capacity of the yards and terminals is increased 33 1/3 per cent. over that obtained with cars of 60,000 lbs. capacity by the use of the 80,000 lbs. cars.

The large car seems, from a weight-carrying standpoint, in every way desirable for many lines that have special traffic, such as ore, coal, stone, bricks and metal, where the cars can be made to carry full loads in at least one direction. Every railroad of importance in the United States has spent large sums of money in reducing grades, improving alignment and remodeling yards. The weights of locomotives are being constantly increased and to get the greatest earning power from these locomotives and to secure the benefit of the large sums expended in improvements in the road, it is necessary to have cars that will carry the greatest possible load without increasing in length.

There is a very large tonnage of ore and coal handled between the Great Lakes and the furnaces and mines located 150 to 200 miles distant therefrom. The ore is brought from the Lake Superior region in vessels and transported from the various ports of Lake Erie to the furnaces, without being stored at the docks. These vessels a few years ago were of a maximum capacity of from 2,500 to 3,000 tons, but now as much as 8,500 tons are carried in one vessel. Quick dispatch is required on the part of the vessel owner, which under conditions prevailing five years ago would be impossible, but by the use of cars of 100,000 lbs. capacity it has been accomplished, and the railroads are handling a much heavier tonnage over the same tracks, and, notwithstanding the earnings per ton mile have been greatly cut down, they have been able to maintain a margin of profit.

A careful record of nearly 200,000 cars handled on two lines of railway leading from Pittsburgh to two of the principal



Engine Rating—Erie & Ashtabula Division. Pennsylvania Lines West of Pittsburg.

ports of Lake Erie shows that it was possible to secure the following loads for their cars:

Ore ....108% of marked capacity
Coal .... 82% of marked capacity

The following table shows the per cent. of marked capacity averaged for large cars:

Number of cars.	Capacity.	% of capacity carried.
3,616	100,000 lbs.	93
136	80,000 lbs.	94
6,727	70,000 lbs.	97

This proves most conclusively that it was true economy under such conditions to build cars of greater capacity than 60,000 lbs.

To bring out the relative changes in increase of dead weight and paying load and the relation of light to the total loaded weight the following table is presented. The first six items are quoted from Mr. Loree's paper and the last two are added from information kindly furnished us by Mr. C. A. Seley, Me-

chanical Engineer, Norfolk & Western Railway, concerning two cars of large capacity designed by him:

Year.	Dead weight of car in pounds.	Paying load in pounds.	Total loaded weight in pounds.	Per Cent of total. Wt. of car.	Per Cent of total. Paying load.
1876	20,500	20,000	40,500	53.62	42.38
1882	24,000	40,000	64,000	37.50	62.50
1889	27,700	60,000	87,700	31.59	68.41
1895	36,000	80,000	116,000	31.04	68.96
1898	38,500	100,000	138,500	27.80	72.20
		110,000	148,500	25.93	74.07
1899*	39,600	105,000	144,600	27.45	72.6
1900†	32,500	88,000	120,500	27.00	73.0

The last two (composite) cars in this list are not included in Mr. Loree's paper, but they are placed by us in the table because of their high standing with reference to the all-steel cars. These Norfolk & Western cars have wheels weighing 650 lbs. and we believe that at least 1,500 lbs. could be taken off the Norfolk & Western cars without sacrificing strength or endurance. If this is done the gondola car would be a 74 per cent. revenue carrier, a remarkable result under the conditions, which warrants this digression from Mr. Loree's argument.

The advantages gained by reducing the length of trains for a given tonnage which are secured by the use of large capacity cars are:

First. That the friction and atmospheric resistance are lessened, and by bringing the moving load closer to the locomotive it can be handled with greater ease.

Second. A smaller number of cars and locomotives is required to move a given tonnage, saving interest on capital and car service, and lessening the empty car movement in the direction contrary to the heavy traffic movement.

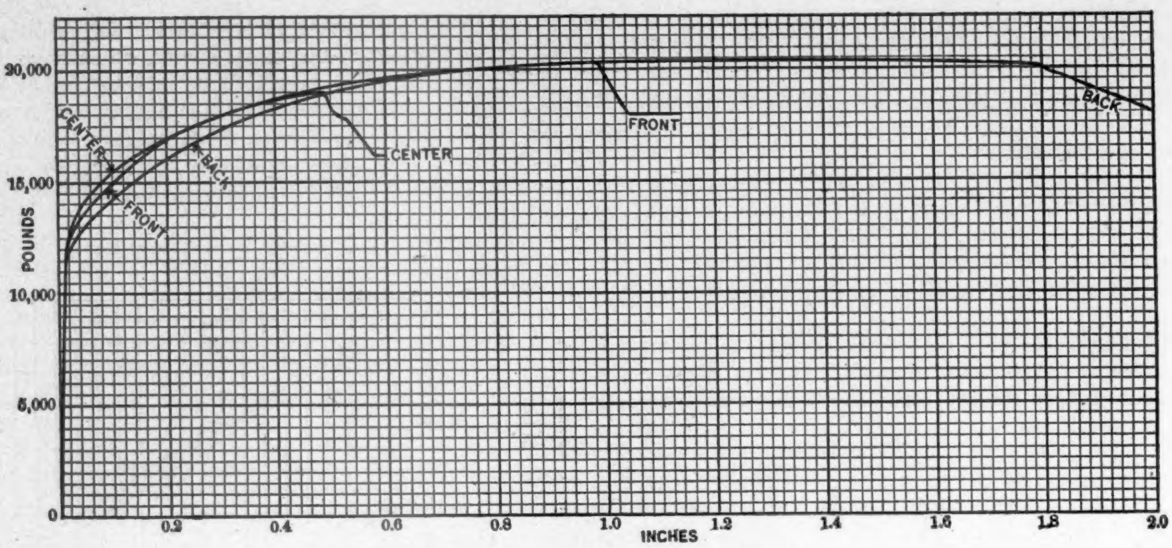
Third. The necessity of increasing the capacity of the main lines, freight yards and shops is avoided, and at the same time the cost of switching is reduced.

Fourth. A large saving in wages results from the decreased number of trains.

These are the reasons for the reduction of the cost per ton mile of hauling freight to figures which were thought to be impossible before the advent of the large car. To illustrate the increase in tonnage which is obtained by decreasing the number of cars in which it is hauled, Mr. Loree prepared the accompanying diagram, which shows the power of various engines on 1 per cent. grades on the Erie & Ashtabula division of the Pennsylvania Lines West of Pittsburg. The diagram also gives the weights and cylinder dimensions of the engines, the rating being based upon a speed of 8 miles per hour.

*50-ton hopper car, composite construction (American Engineer, June, 1899, page 187).

†40-ton gondola car, composite construction (American Engineer, April, 1900, page 100).



The Effect of Overheating a Crown Sheet.

THE EFFECT OF OVERHEATING ON DUCTILITY.

By Prof. Wm. T. Magruder.

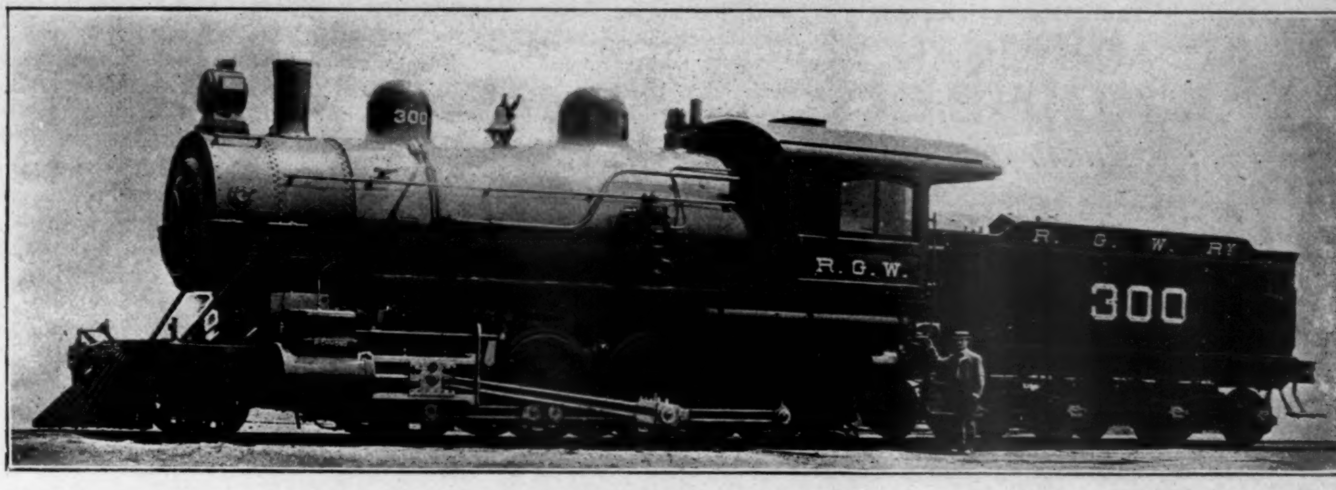
Herewith are presented the record and a copy of the autographic stress-strain diagrams obtained from coupons cut from the front, center and back respectively, of the crown sheet of a Belpaire locomotive boiler. The locomotive was first put into service in July, 1894. In December, 1897, it was slightly scorched or overheated, due in all probability, to low water. It became badly pocketed between the heads of the crown sheet stays, but there was no explosion or giving way of the sheet. The plate was purchased on specifications calling for 55,000 to 65,000 lbs. per sq. in. of tensile strength and 28 per cent. elongation in 8 in.

	Front.	Center.	Back.
Size, inches	1 × 0.335	1 × 0.337	1 × 0.324
Area before testing, sq. inches	0.335	0.337	0.324
Area after testing, sq. inches	0.240	0.271	0.144
Per cent. reduction in area	28.4	19.6	55.55
Strength, lbs. per sq. in.,			
at elastic limit (= Y P.)	38,060	37,090	37,040
at maximum	60,300	56,380	63,270
at final	53,730	48,960	52,470
Elongation in 8 inches	1.09	0.53	1.97
Per cent. of elongation	13⅝	6⅝	24⅝

The tests and autographic diagrams were made on an Olsen 100,000 lb. automatic and autographic screw machine. The report tells the story in figures, and the diagrams illustrate them graphically. It is to be noted that the 28 per cent. elongation (when new), in a test section 8 in. long is reduced to 24⅝ per cent. at the back test section, to 6⅝ per cent. at the center and to 13⅝ per cent. at the front test section, after the use that it received; that the reduction in area is reduced from 55.55 per cent. at the back to 19.6 per cent. at the center, and to 28.4 per cent. at the front test section; and that the maximum strength is reduced from 63,270 lbs. per sq. in. at the back to 56,380 lbs. per sq. in. at the center. The center coupon showed the highest modulus of elasticity. It gave a rounded diagram, whereas the back coupon gave a sharp corner at the yield point.

The center coupon, after fracture, shows a ruptured or checked surface, on the side of the plate which was next to the water, in places originally about four inches apart and midway between the crown stay rivets. It is quite uniformly but less deeply checked on the fire side. The front coupon is checked only on the fire side, and only near the place of fracture which is at a line of rivets.

While the sheet did not give way and cause a boiler explosion with the attendant loss of life and property, the tests show that the ductility of the sheet had been practically destroyed, and confirm the judgment of the person who ordered it to be replaced.—Stevens Indicator.



CONSOLIDATION LOCOMOTIVES.

RIO GRANDE WESTERN RAILWAY. RICHMOND LOCOMOTIVE WORKS, *Builders.*

Weights: Total of engine ....185,000 lbs.; on drivers ....168,400.
Wheel base: Driving, 16 ft. 8 in.; total of engine and tender, 52 ft. 11 in.
Cylinders: 22 x 28 in. Wheels: Driving, ... 50 and 56 in.; truck ....30 in.
Boiler: Radial stay, extended wagon top; diameter ......74 in.; boiler pressure.......... 185 lbs.
Firebox: Length .....122 in.; width ... .41 1/16.; depth, front.... ....77¼ in.; depth, back............71 in.
Grate area ....347 sq. ft. Tubes: 318, 2¼ in.; 14 ft. 3 in. long.
Heating surface: Tubes ....2,667 sq. ft.: firebox............206 sq. ft.; total.... .. 2,873 sq. ft.
Tender: Eight-wheel; tank capacity, 5,000 gals.; coal capacity...........10 tons.

HEAVY CONSOLIDATION LOCOMOTIVES.

Rio Grande Western Railway.

The Rio Grande Western Railway has just received eight heavy consolidation locomotives from the Richmond Locomotive Works, one of which is illustrated in the accompanying engraving. The engines are identical in all details, except driving wheels, four of them have 50-inch and the other four 56-inch drivers. The principal dimensions are given in the accompanying table.

General Dimensions.

Gauge	4 ft. 8½ in.
Fuel	Coal
Weight on drivers	168,400 lbs.
Weight in working order	185,000 lbs.
Wheel base, driving	16 ft. 8 in.
Wheel base, total engine and tender	52 ft. 11 in.
Total length of engine and tender	63 ft. 2¼ in.

Cylinders.

Diameter	22 in.
Piston stroke	28 in.
Piston packing	Cast iron
Piston rod, diameter	4 in.; material, iron
Steam ports	1⅝ in. by 21 in.
Exhaust ports	3¼ in. by 21 in.
Bridge, width	1½ in.

Slide Valves.

Style	Richardson balanced
Greatest travel	6 in.
Lap, outside	1 in.
Lap, inside	0 in.
Lead in full gear	1/32 in.

Wheels.

Driving, number	8
Driving, diameter	56 in.
Driving centers, material	Cast steel
Driving box, material	Cast steel
Driving axle journal	9 in. by 12 in.
Crank pin, main	Steel, 7 in. by 6½ in.; 7¼ in. by 5⅞ in.
Crank pin slide rods	Steel, 5¾ in. by 4½ in.; 5¾ in. by 4¾ in.; 6¼ in. by 5⅜ in.
Engine truck, style	Center bearing, swing motion
Engine truck wheels	Number, 2; diameter, 30 in.
Engine truck wheel centers	McKee Fuller C-iron
Engine truck axle	Steel
Engine truck journals	6½ in. by 10 in.

Boiler.

Type	Radial stay, extended wagon top
Working pressure	185 lbs.
Outside diameter, first course	74 in.
Thickness of plates in barrel	¾ in. and 13/16 in.
Thickness of plates, roof and sides	⅝ in.
Firebox, length	122 in.
Firebox, width	41 1/16 in.
Firebox, depth	Front, 77¼ in.; back, 71 in.
Firebox material	Steel
Firebox plates	Sides, 11/32 in.; back, 11/32 in.; crown, 11/32 in.; tube, ½ in.
Firebox water space	Front, 4½ in.; side, 4 in.; back, 4 in.
Firebox crown stays	1⅛ in.
Firebox staybolts	15/16 in. and 1 in.
Tubes, material	Iron
Tubes, length	14 ft. 2⅞ in.
Tubes, number	318
Tubes, diameter	2¼ in.
Tubes, thickness	No. 12 B. W. G.
Heating surface, tubes	2,667 sq. ft.
Heating surface, firebox	206 sq. ft.
Heating surface, total	2,873 sq. ft.
Grate, style	Rocking, finger
Grate area	347 sq. ft.
Exhaust pipe, style	Single
Exhaust pipe nozzle	5½ in.
Smokestack, smallest inside diameter	15 in.
Smokestack, top above rail	14 ft. 8½ in.

Tender.

Weight, empty	43,200 lbs.
Frame	Steel
Wheels, number	8
Wheels, diameter	33 in.
Journals	5 in. by 9 in.
Whele base	17 ft. 11 in.
Tank capacity, water	5,000 gals.
Tank capacity, coal	10 tons

A good arrangement of tracks for repairing freight cars is in use at the yards of the Chicago, Milwaukee & St. Paul Railroad, at West Milwaukee. From the main track leading into the repair yard are 15 short tracks branching out to the left at angles of about 35 degrees. These tracks are for light repairs and have a capacity of 10 cars each. The 3d, 8th, and 13th tracks are used as supply tracks, each one furnishing the materials used on four repair tracks, two on either side. To the right of the main track and running parallel with it are two tracks with a covering overhead. These tracks are used for heavy repair and are 720 ft. long, which does not in this case accommodate all of the cars for this class of work, so that some of this work is done on the tracks for light repairing. From this arrangement of light repair tracks it will be seen that when 4 or 5 cars are completed they can be taken out for immediate use without disturbing a whole line of cars and probably keeping the men from their work for 5 or 10 minutes while the cars are being shifted. With a force of 130 men an average of 160 cars are repaired each day on these tracks.

The "personal equation" is thoroughly believed in by Mr. J. Dixey, the new Master Car Builder of the Ohio Southern R. R. He was formerly connected with the C., B. & Q., and one characteristic of his work is to spend a great deal of his time among his men showing his personal interest in what they are doing. In this he is carrying out an idea which has made the success of many men. Mr. Franklin, Superintendent of this road, has designed and superintended the building of an excellent officers' pay car at the shops of the line. The car, named "Waverly," resembles the work of the Pullman shops in design and neatness of execution. It is small, but very well arranged.

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EDITORIAL ANNOUNCEMENTS.

Advertisements.—*Nothing will be inserted in this journal for pay,* EXCEPT IN THE ADVERTISING PAGES. *The reading pages will contain only such matter as we consider of interest to our readers.*

Special Notice.—*As the* AMERICAN ENGINEER AND RAILROAD JOURNAL *is printed and ready for mailing on the last day of the month, correspondence, advertisements, etc., intended for insertion must be received not later than the 20th day of each month.*

Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase or construction.*

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M. C. B. 5½ BY 10 JOURNAL BOX.

New journal boxes for 5½ by 10 inches M. C. B. axles are breaking and it has been found necessary on several roads to make a change in the patterns in order to prevent the bearings from striking the inner wall of the dust guard space. It may be too late to direct attention to the defect in the proposed new standard box with a view of influencing the letter ballot on the adoption of the standard, but the criticism may lead to a reconsideration of the design if it is approved in its present form by the letter ballot.

In another part of this issue Mr. F. M. Whyte, mechanical engineer of the New York Central, reviews the subject thoughtfully and suggests a simple remedy which it has already been found necessary to apply to the journal boxes of this size on that road. It appears that the clearances at the back end of the box, between the bearing and the box, are not enough to provide for the natural roughness of unfinished castings. One-sixteenth inch is not sufficient and the bearing may strike the end of the box before the endwise motion is arrested by the lugs. Clearances which were sufficient for boxes for 3¾ by 7-inch journals are evidently too small for the largest sizes. The stresses are greater with the heavier loads on the large journals and furthermore the opening at the back end of the small box was large enough to let the bearing pass through. The simple remedy of enlarging the opening for the large box will solve the difficulty.

A change in the journal is not to be thought of and the dust guard space and thickness of the rear walls must be maintained. Mr. Whyte's suggestion is to cut out that part of the inner wall at the back where it can be struck by the present bearing. It will not materially affect the strength of the box and there seems to be no objection to the change. The same change appears to be necessary in the 4¼ by 8 and the 5 by 9 boxes. In other words, it must be done in the three largest M. C. B. standard journal boxes. It is easy to understand how the oversight occurred. The cutting away of the back wall has not been made to correspond with the enlargement of the bearings when the larger boxes were designed, and the trouble has been developed by the increase in the stresses which have accompanied the increased loads placed upon the larger journals. The enlargement of the hole has been made by increasing the radius of the top of the opening, but Mr. Whyte shows that the opening should not be cut to a radius but to a shape more nearly conforming to the shape of the bearing.

This will, of course, be remedied by those who are using the journal boxes, but it should have the prompt attention of the association.

Of the four scholarships at Stevens Institute of Technology, endowed by the Master Mechanics' Association, one is vacant, and candidates who have obtained the necessary certificate from Mr. Joseph W. Taylor, Secretary of the Association, will be examined at the Institute, September 16, 17, 18, 19 and 20. There is no doubt of the appreciation of this opportunity on the part of sons of employees or sons of deceased employees of the mechanical departments of our railroads, but it seems strange that there is not a waiting list of those who desire this educational opportunity. The possibilities so generously offered by the Association may not be sufficiently well known and understood among the young men who are eligible, and for this reason we mention the vacancy prominently and suggest that notices be posted upon shop bulletin boards in order to bring the scholarships before the young men who are eligible.

The argument in favor of cars of large capacities by Mr. Loree, which is presented in condensed form in this issue, records the experience of the Pennsylvania Railroad, one of the pioneers in the use of large steel cars. We find it interesting as a record and also because it suggests a study of car design with reference to maximum capacity and minimum dead weight. It may be surprising to many readers to note the comparison in this respect between the large steel cars referred to by Mr. Loree and the two composite cars designed and built by the Norfolk & Western, the weight and paying load ratios of which are remarkably high. This shows what can be done in composite construction with a frame of steel and box and floors of wood. The 100,000-lb. car listed by Mr. Loree appears to be a specially light one and not the pressed steel car which was exhibited at Saratoga. That car, as we remember it, was stenciled 39,800 lbs., which is slightly heavier than the Norfolk & Western hopper car. We are not haggling about small differences in weights, but are endeavoring to point out the possibilities of satisfactorily combining wood and metal for those who desire composite construction.

20-FOOT BOILER TUBES FOR LOCOMOTIVES.

For several years there has been a tendency toward lengthening locomotive boiler tubes and it seems likely to receive considerable impetus through the influence of wider fireboxes for bituminous coal. The tendency is not only to use longer tubes but to increase the ratio of length to diameter, and one motive power officer writes that he has changed the tubes in a mogul engine from 2 in. to 1¾ in. without changing the length, which was 12 ft. 6 in., and has "done wonders with them." He is also using 2¼ in. tubes, 16 ft. long and has no fear of them.

Sixteen feet is common enough now to cause no comment when this dimension appears in a new engine. Mr. S. M. Vauclain advocates 2 in. tubes 20 ft. long, and at the present time a length of 19 ft. has been adopted in a new design for fast passenger service, the diameter in this case being 2¼ in. We think that there are enough straws to indicate which way this wind is blowing. The wide firebox has raised the question of the length of tubes because of its effect upon wheel arrangements. The desire to use long tubes is increased by the necessity of getting large wheels in front of the mud ring.

The relation between the length and diameter is most important, and it is to this that special attention should be directed. The length should not be increased without consideration of this ratio and there are good reasons for believing that an increase in the prevailing ratio is desirable.

In European (Continental) practice the ratio has been 60 for express engines, it has been about 75 in English practice, and from 70 to 80 in American, although Mr. G. R. Henderson has suggested the limits of 70 and 90.

The Pennsylvania Class E1 locomotive was designed with a view of using a ratio of 90, although 86 was finally employed. This shows the tendency toward increasing the ratio and a new design, for which drawings are now completed, will use 19 ft. tubes with a ratio of 100. In Russia 2-in. tubes are in use with a ratio of 108, the length being 18 ft. 1 in., and if Mr. Vauclain should put his idea into practice we shall have a ratio of 120 with 2-in. tubes 20 ft. long.

The famous experiments of M. Henri, chief engineer of the Paris, Lyons & Mediterranean (American Engineer, August, 1890, page 337), and the opinion based upon them has unquestionably influence locomotive practice in confining tube lengths in general practice between 12½ and 14 ft. These tests showed a gain of 7 per cent. in evaporation by an increase from 13 to 16 ft. in length without changing the diameter and tubes 23 ft. long gave 30 per cent. more evaporation than those of 10 ft. The 23 ft. tubes, however, increased the draft resistance. These tests, however, used drafts of 1 to 2.95 in., and drafts of 14 or 16 in., such as occur in American practice might change the conclusions entirely. M. Henri used 78 lbs. of coal per square foot per hour as a maximum rate of combustion. When 250 or 300 lbs. are burned per hour the velocity of the gases in the tubes is vastly greater and therefore these experiments now seem to point toward the desirability of much longer tubes in this country, at least that is the view taken by several well-known men.

Increased friction and reduced draft effect will undoubtedly result from increased lengths of tubes, but we believe that there is much more to be gained in the greater heat absorption than will be lost in these ways. Two different tubes with the same ratio of length to diameter will give the same efficiency for the same velocity of the gases and the long tube may be made larger if necessary. Even if it causes a slight sacrifice in amount of heating surface it is possible that the greater length will be more advantageous than slightly more heating surface in shorter tubes. To determine this positively a very difficult test must be made.

The influence of velocity of the gases has been referred to before in these columns* in connection with Wohler's mathematical analysis of Henri's experiments. The velocity of the gas current affects the action between the gas and the heating surface as does the temperature. The period of contact of the molecules varies inversely as the velocity of the current. Wohler has worked out a table (Bulletin of the International Railway Congress, June, 1899, page 820) to show his idea of the proper ratio of length to diameter required to obtain different degrees of efficiency when the velocity of the gases varies from 5 to 20 ft. per second. These figures call for a ratio of 100 when ordinary efficiency is expected and of 130 as a maximum when the velocity is 20 ft. per second. It is our opinion that in recent practice the velocities greatly exceed 20 ft. per second. The higher the velocity the longer the tubes should be, and for locomotives with high rates of combustion there is good reason to believe that the tubes cannot be too long within the limits imposed by restrictions of weight and space.

M. Henri proved that with light drafts 23-ft. tubes gave an advantage of 12 per cent. over 13-ft. tubes in water evaporation per pound of coal. We may yet come to the 23-ft. tubes, but before this point is reached the Serve tube should come up for consideration. For a given diameter Serve tubes have a heat absorbing surface 75 per cent. greater than that of ordinary tubes, but they are expensive.

There seems to be but one anxiety in the use of long tubes, that concerning the expansion and contraction and its effect upon leakage at the tube sheets. This fear may prove to be without foundation, but if not there is a simple remedy in cambering the tubes by giving them a slight bend before being placed in the boiler. Cambering has been practiced for five years on the Caledonian Railway of Scotland, and we are informed by Mr. J. F. McIntosh, locomotive superintendent of that road, that it was inaugurated for the purpose of relieving the tube sheets from these effects and also to increase the resistance of tubes to bending by their own weight and thereby lessen the injurious effects of vibration in producing leakage at the tube ends. In the opinion of Mr. McIntosh, when the tubes are cambered they are more flexible longitudinally and therefore yield more freely to the expansion and contraction and reduce the stresses at the tube sheets. The tubes are generally cambered by the manufacturers, but this has been satisfactorily done in the shops of the Caledonian in a screw press.

*Article by Mr. Wm. Forsyth, October, 1899, page 311.

NOTES.

RAILROAD MILEAGE IN THE UNITED STATES.

On June 30, 1899, the total single-track railway mileage in the United States was 189,294.66 miles, an increase during the year of 2,898.34 miles being shown. This increase, according to the Interstate Commerce Commission, is greater than for any other year since 1893. The States and Territories which show an increase in mileage in excess of 100 miles are Alabama, Arkansas, Georgia, Louisiana, Michigan, Minnesota, Pennsylvania, Texas, Arizona, New Mexico and Oklahoma. Practically all of the railway mileage of the country is covered by reports made to the Commission, the amount not covered being 1,759.98 miles, or 0.93 per cent. of the total single-track mileage. The aggregate length of railway mileage, including tracks of all kinds, was 252,364.48 miles. The distribution of this aggregate mileage was as follows: Single track, 189,294.66 miles; second track, 11,546.54 miles; third track, 1,047.37 miles; fourth track, 790.27 miles; yard track and sidings, 49,685.64 miles.

The increased capacity of modern locomotives on our best roads is strikingly illustrated by a reference in the recent annual report of the Chicago & Northwestern stating that during the year 82 locomotives have been built to replace the same number of old ones. The new ones have an aggregate tractive power equivalent to that of 203 engines of the old class, the gain being 147½ per cent.

PERSONALS.

Mr. William Hunter, Acting Chief Engineer of the Philadelphia & Reading, has been appointed Chief Engineer.

Mr. W. G. Tait has been appointed Purchasing Agent of the Wisconsin & Michigan, with office at Chicago.

It is officially announced that Mr. J. S. Turner is appointed Master Mechanic of the Fitchburg Division of the Boston & Maine, with office at Charlestown, Mass.

Mr. Charles Hansel has been appointed General Manager of the General Power Company, manufacturers of the Secor internal combustion engine, with offices at 100 William Street, New York.

The University of Michigan has conferred upon Mr. A. A. Robinson, President of the Mexican Central, the degree of Doctor of Laws, in consideration of his "eminence as an engineer and railway administrator."

Mr. W. F. Dixon informs us that he has resigned as Chief Engineer of the Sormovo Works at Nijni-Novgorod, and become connected with the Singer Manufacturing Company. His new address is Podolsk, Moscow Government, Russia.

Mr. James Dun, Chief Engineer of the Atchison, Topeka & Santa Fe, has been appointed Chief Engineer of the entire Santa Fe system. Mr. W. B. Storey will succeed Mr. Dun as Chief Engineer of the Atchison, Topeka & Santa Fe Railway.

Robert S. Hughes, President of the Rogers Locomotive Company, died recently at his home, in Paterson, N. J. Mr. Hughes was 73 years old and his life-work has been with the Rogers Locomotive Company and the firms which it succeeded.

Mr. Richard D. Gallagher, Jr., has been appointed Mechanical Engineer of the Standard Coupler Company. Mr. Gallagher has for some time been connected with the car department of the Grand Trunk Railway at Montreal, and was formerly with Pullman's Palace Car Co. at Pullman.

Mr. J. R. Groves, recently Superintendent of Machinery of the St. Louis & San Francisco, has been appointed to a like position with the Colorado Midland, with headquarters at Colorado City, to succeed Mr. A. L. Humphrey, who resigned in June to become Superintendent of Motive Power of the Colorado & Southern.

Mr. Frederic A. Miller, who is to succeed Mr. G. F. Heafford as General Passenger Agent of the Chicago, Milwaukee & St. Paul at Chicago, entered the General Passenger Department of this company in 1883 as a clerk. Two years later he was appointed General Agent, and in 1887 Assistant General Passenger Agent, which position he now holds.

Mr. F. E. Blaser, of the Chicago, St. Paul, Minneapolis & Omaha, has been appointed Purchasing Agent of the Ohio River. He entered the services of the Chicago, St. Paul, Minneapolis & Omaha at the age of 11 years, as a spike peddler and water carrier, and has worked through various responsible position. His entire railroad career has been spent with this company.

Collis P. Huntington, President of the Southern Pacific, and one of the most prominent financial magnates of the present time, died suddenly August 14, at Pine Knot Camp, his summer home, in the Adirondacks. Mr. Huntington was 79 years old, and a large part of his history is bound up with the construction of the Central Pacific. He went to the Pacific coast in 1844 during the days of the gold rush and entered into the trading business on a very small scale, with the money he had previously saved from peddling and trading. His capital grew until, with Mark Hopkins, Leland Stanford and Charles and E. B. Crocker, he organized the Central Pacific Railroad Company, the organization and growth of which, form a very interesting and instructive chapter in the history of railroad growth. The organization of the Southern Pacific followed, in which 26 corporations were absorbed. Among other great properties which owe their existence to Mr. Huntington's foresight are the Pacific Mail Steamship Company and the Newport News Dry Dock and Shipbuilding Company. He was also interested in many varied companies as a director.

ACETYLENE FOR RAILROAD LIGHTING.

In a paper by Mr. A. Lipschultz, of the Great Northern Railway, published in the June number of the "Journal of the Association of Engineering Societies," we find a carefully considered discussion of the application of acetylene to railroad conditions. Mr. Lipschultz describes what appears to be an excellent field for acetylene as follows:

The Great Northern Railway has at Hamline a freight transfer house, which consists of a warehouse about 800 ft. long, having loading platforms at each side for the entire length of the building. The offices are located at one end of the structure. There are altogether about 100 burners, of which 26 are in the office, while the rest of them are grouped in three rows; one row being in the center of the freight house, and the other two rows on the platforms. The generator is installed in a small building about 20 ft. distant, which also serves as a dining room for the men. The office lights burn all night, while the lights in the freight house and platforms are needed for about four hours daily in the winter. The generator is a 100-lb. carbide machine, and is charged every other day. The cost per lamp-hour (22 c. p.) varies from 0.55 cent to 0.65 cent, according to the amount of gas used. This includes attendance, depreciation and renewals. The light furnished by the acetylene plant has reduced the cost per ton of freight handled, and no other system of lighting could be installed at that place which would rival it in economy. We have now a number of passenger stations and freight depots equipped with acetylene plants in operation, and several others under construction, ranging from 20 to 60 lights each, and in no case has an acetylene plant been decided upon except where, by its smaller operating cost, its independence of rented sources of light and its fine illuminating qualities, it has shown itself to be superior to other systems of lighting.

The author of the paper then turns to train lighting and soon disposes of all methods of using gas generators on the trains themselves. With small generators the heat of the chemical action renders the gas impure and this leads to the stopping up of pipes and burners. The charging of generators is always objectionable on account of the odor, and the amount of care required of the train men is considered a serious disadvantage. Only in the system in which the gas is made in a central plant and stored under pressure on the cars is the train crew relieved from attendance and "this in itself is a grave inconvenience." The railroads have been educated through the present compressed gas system to demand that the lighting of trains shall require only the minimum amount of attention from the train men, and systems which require careful regulation of apparatus will not be acceptable.

Mr. Lipschultz discusses at some length the effect of pressure upon the safety of acetylene. In Europe the Pintsch people use mixtures of acetylene and Pintsch oil gas to enrich the gas and there was no danger of explosion when a tank of this mixture at 150 lbs. per sq. in. was heated to the dissociating tem-

perature of pure acetylene. According to the author of this paper, acetylene when stored under a pressure of not more than 30 lbs. cannot produce a dangerous explosion when heated to the dissociating point, and the system of lighting suburban trains having short runs with acetylene carried in tanks at 30 lbs. pressure has been in successful operation for several years. This low pressure, however, is inadequate for long-distance trains and, says the author, in order to use acetylene stored at the same pressure as in the system of the Pintsch Gas Company, this latter company made tests with acetylene stored under 150 lbs. pressure; first in a tank having riveted seams, and then in its own standard tank which has riveted and soft-soldered seams. When the tank with riveted seams was heated to the dissociating point, or about 1,432 degrees F., an explosion took place which demolished the tank. In the second test with its own tank, having soft-soldered seams, the solder commenced to melt when a temperature of about 380 degrees F. was reached, thereby springing a leak by which the gas escaped, burning out quietly without any injury to the tank. It was therefore concluded that acetylene under 150 lbs. pressure stored in such a tank could be carried safely even in case of an accident by which the car might be overturned and the wreck catch fire. As already mentioned, there are no means of exploding a tank filled with acetylene gas at high pressure except by heating it to or above a temperature of 1,432 degrees F., as neither shock nor concussion will produce an explosion.

The paper points to the possibility of an explosion in the event of a wreck by heating the high-pressure pipes leading from the gas tank to the reducing valves. This pipe might be heated at a point about 4 ft. away from the tank and in such a way that the seams of the tank would not be melted and an explosion occur. To guard against this the system described by Mr. Lipschultz employs piping which will melt at a temperature of 400 degrees F. These pipes are believed to overcome the difficulty entirely and "render an explosion impossible," but it is nevertheless considered necessary to provide a safety valve by which the gas escapes when a derailed car turns on its side.

According to this authority, economy can be had only in the manufacture of acetylene in a central station plant where a gas of high candle-power is produced. The entire plant can be run by one man, even if the plant has a daily capacity of 10,000 ft., which is equivalent to more than 30,000 ft. of Pintsch gas. A tank under a coach can be filled by unskilled labor in from two to three minutes, and, after this operation is performed, only the lighting and turning off of the lamps remain to be done by the train men.

It is rather disappointing to fail to find in the paper any reference to the clogging of burners. The Pintsch people in their long successful experience do not consider it wise to use a richer gas than that which gives from 10 to 12 candles per cu. ft. This was discussed in our issue of October, 1899, page 329, where it was stated that a change from a diameter of orifice of 0.023 in. to 0.029 in. was a great improvement. The lighting of trains is a peculiar service in this respect and a system which is entirely satisfactory for stationary lighting may give serious difficulty on trains for this reason. Richer gas would require smaller orifices, and this is a question which has not been touched upon in this discussion. It is believed to be important.

While acetylene seems to be a very attractive source of light for many purposes, conservatism in accepting it as a safe medium in view of the precautions mentioned by the author of this paper is fully justified, especially for train lighting.

The author of the paper is enthusiastic about acetylene for car lighting, but, as we understand it, his favorable opinion is based upon expectations rather than extended experience. The present compressed gas system in general use is so satisfactory that anything entering the field against it must be ideal in every respect and particularly with regard to reliability and easy maintenance.

BRAKE BEAM PRESSURES.

Unexpected Stresses Developed by Tests.

That brake beams are subjected in ordinary service to excessive stresses and even beyond the requirements of the Master Car Builders' Association has been demonstrated in a series of interesting tests by the University of Illinois, made with the assistance of Mr. H. M. Perry, of the Chicago Railway Equipment Company, and Mr. McClurg, Master Mechanic of the Peoria & Eastern Railway, in the yards of that road at Urbana, Ill. The chief object of the tests was to ascertain the effect in brake beam pressure of suddenly starting a car upon which the brakes had been set while at rest. Fig 1 illustrates the action. The shoe S, being below the center of the wheel,

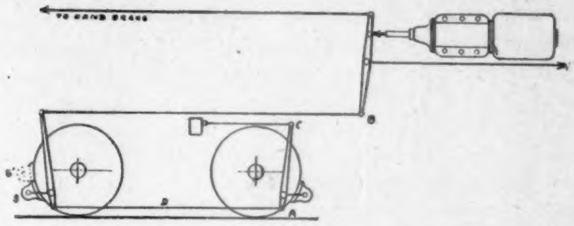


Fig 1.

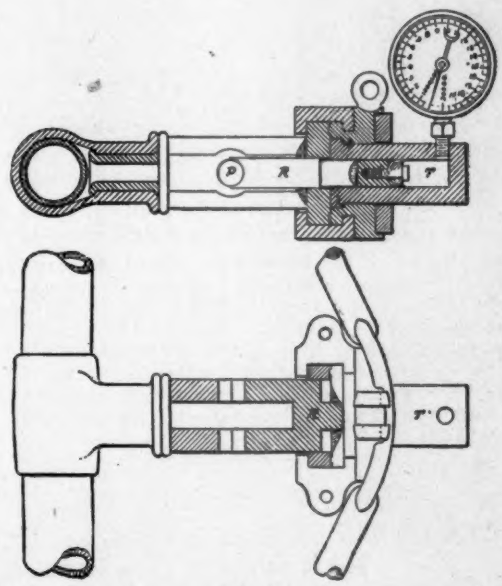


Fig. 2.

will rise to a position represented by the dotted brake head when the car is started toward the right. This will increase its distance from A and increase the tension in the rod D, because there can be no yielding at C.

Brake beams were fitted, as shown in Fig. 2, with a hydraulic gauge to measure the pressure on the brake beam. Pressure was transmitted to the brake beam through a plunger sliding in the strut, R, which communicated the pressure to the oil cylinder T and permitted of measuring it with the gauge. These beams were applied to two cars, one of which was new and had run only long enough to make its journals and brake-shoes smooth, while the other was an old car with slack bearings and brake rigging. The braking power was 64.7 per cent. for the new car and 64.3 per cent. for the old one. After both had been run over a sanded track to insure good contact between the shoes and wheels, the brakes were set firmly by air or by hand when the cars were standing. Then the cars were suddenly started and the rising of the brake-shoes caused the brake beam pressures to increase, as was explained.

In the test of the old car the brake beam pressure, when the brakes were set by hand, ranged from 5,800 to 8,000 lbs. This was increased from 22 to 47 per cent. by the rise of the

shoes. In the case of the new car the brake beam pressures when set by air ranged from 4.200 to 4,750 lbs., and these were increased, on starting the car, from 10.5 to 31 per cent. In another test with this car the brakes were set by hand, giving pressures ranging from 4,200 to 10,450 lbs., and these were increased in starting from 12 to 114 per cent.

These are wide ranges and there are so many opportunities for variation in the conditions as to render an average misleading. The highest pressure, 14,050 lbs., is more than 2½ times the pressure calculated for an emergency application and this should be considered by those who are defending their use of weak and cheap brake beams on the ground that emergency applications are so rare that they can afford to take chances with brake beams which are known to be too weak to withstand them. Here is proof that in ordinary use of cars the brake rigging may be subjected to several times the amount of stress supposed to be produced by emergency applications and the natural inference is that brake beams should be made as strong as possible. This rise of the brake beam will occur also in braking on the road and it is possible that the pressures may be increased in emergency applications in fast trains even beyond the figures found in these tests.

The tests also exposed weaknesses in foundation brake gear, chains, hangers and ratchet keys gave way repeatedly. The conditions were exceptionally severe, but they represent what may and probably often does occur in the rough handling of cars in switching. If other service proves to be still more severe there is good reason for revising foundation brake gear design. The M. C. B. standard for brake beams calls for a deflection of not more than 1/16 in. under a load of 7,500 lbs. at the center, and if it is necessary to use a stronger beam the specifications call for 15,000 lbs. with a deflection of not more than 1/16 in. It would be well to investigate present practice on this basis and bring the rest of the gear up to this standard.

It must be remembered that these tests concerned only outside hung brakes. If the shoes were placed between the wheels the destructive rise of pressures would not occur and these experiments add a strong argument to the many in favor of the inside arrangement. With the present high speeds of freight trains there is no danger of giving too much attention to the brakes, but there seems to be considerable danger of neglecting to bring them up to the requirements imposed by conditions which are changing continually in the direction of greater severity.

RAILROAD EMPLOYEES IN THE UNITED STATES.

The number of persons employed by the railways of the United States as reported to the Interstate Commerce Commission on June 30, 1899, was 928,924, or an average of 495 employees per 100 miles of line. As compared with the number employed on June 30, 1898, there was an increase of 54,366, or 21 per 100 miles of line. From the classification of these employees it appears there were 39,970 enginemen, 41,152 firemen, 28,232 conductors and 69,497 other trainmen. There were 48,686 switchmen, flagmen and watchmen. Upon the basis of special returns made to the secretary of the commission, it appears that the number of switchmen, flagmen and watchmen included in this aggregate could fairly be assigned in the proportion of 6, 3 and 2, respectively.

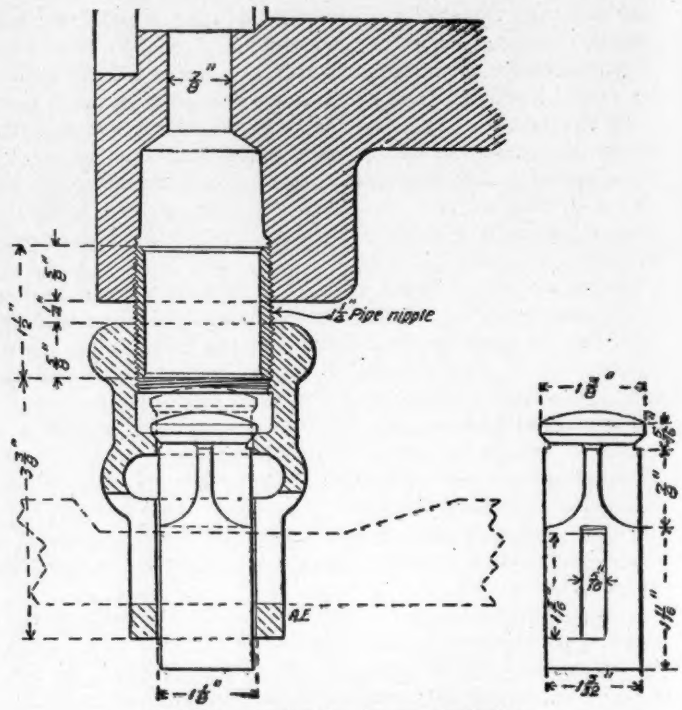
Disregarding 9,334 employees not assigned to the four general divisions of employment, it is found that the services of 34,170 employees were required for general administration, 287,163 for maintenance of way and structures, 180,749 for maintenance of equipment and 417,508 for conducting transportation.

The report contains a statement of the average daily compensation of eighteen classes of employees for eight years, beginning with 1892. A summary in the report also gives the total compensation of more than 99 per cent. of railway employees for the fiscal years 1895 to 1899. During the year ending June 30, 1899, $522,967,896 were paid in wages and salaries, an amount $77,459,635 in excess of that paid during 1895. The compensation of the employees of railways for 1899 represents 60 per cent. of their operating expenses and 40 per cent. of their gross earnings.

CYLINDER COCKS FOR LARGE CYLINDERS.

Some railroads in following established standards perhaps too closely, or too long, have lost sight of the fact the cylinder cocks which were efficient some years ago will not quickly drain the water from cylinders of modern locomotives, which may be several inches larger in diameter than was used or contemplated when the cock was made a standard. Mr. C. A. Seley, Mechanical Engineer of the Norfolk & Western, has kindly sent us a drawing showing the present practice on that road.

It is not improbable that the low-pressure cylinders of compound locomotives, measuring 35 inches in diameter, are provided with a ½-inch drainage hole and a cock originally designed for a 16 or 17-inch cylinder. This is a point to be looked after, particularly in locomotives with piston valves, as these



Cylinder Cocks for Large Cylinders.
Norfolk & Western Railway.

valves cannot lift to relieve the pressure, and the relief valves may be inefficient or absent altogether. With a good cylinder cock, however, the water may be quickly discharged if caught in time.

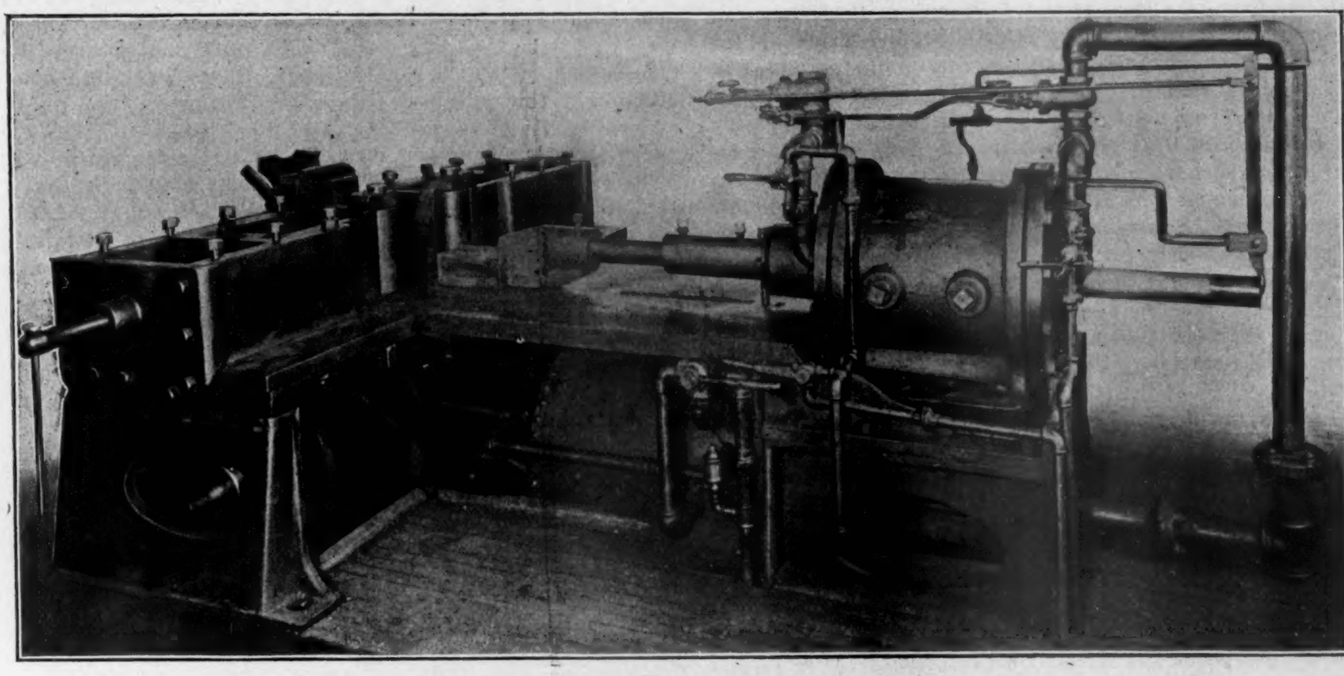
Cylinder cocks are frequently knocked off, and when this is done, with many designs they are only valuable as scrap. This is particularly true of those styles that have a threaded shank to screw into the cylinder. Break off the shank and the cock is useless and thrown into the scrap. A design, not original. but perhaps new to some, has been made standard on the Norfolk & Western Ry., which has a very free delivery and can be used again if knocked off. The idea of mounting the cock on a nipple is not original. This was done some years ago on the Southern Pacific, but the application so arranged as to make use of existing cylinder cock rigging without change is novel.

The drawing shows that the cock has been made rather stocky, particularly around the thread, which is made to rereceive a 1¼-inch pipe nipple. Ordinarily the nipple will break when the cock is hit, and it can be dug out, replaced and the cock used again. The passages are made so as to pass the full area of a ⅞-inch hole which is the size of the hole drilled up into the cylinder, although it could be made larger if desired. These cocks are very inexpensive to make so far as cost of finish is concerned, and they have proved very satisfactory in service.

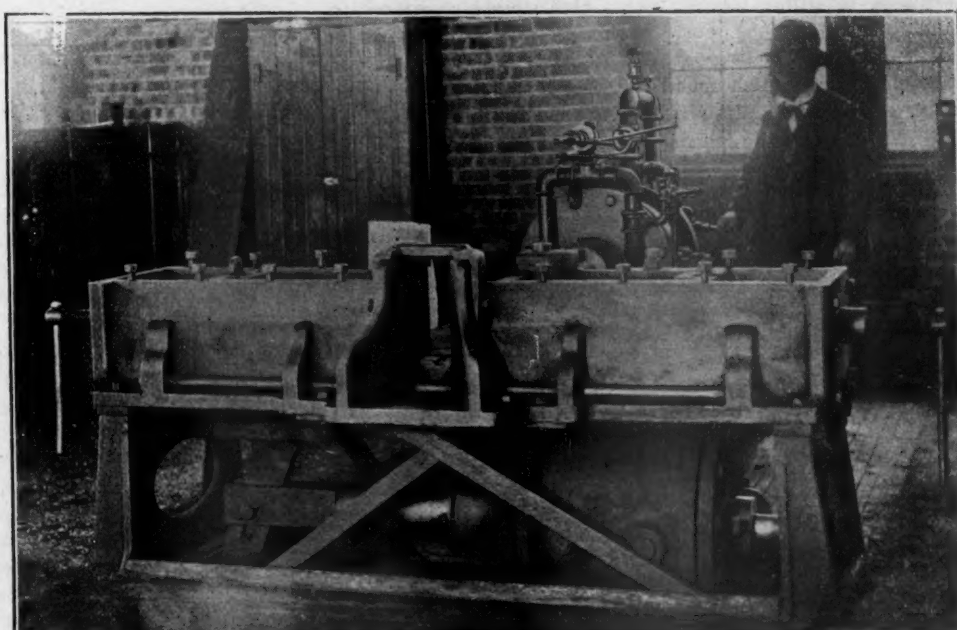
HEAVY PNEUMATIC FORGING MACHINE.

Illinois Central Railroad.

A very powerful pneumatic forging machine is in course of erection at the Burnside shops of the Illinois Central Railroad. It will perform all the functions of a forging machine, riveting machine and a bulldozer, and is not improperly called a "mechanical blacksmith." It is very simple of construction and operation, is limited in speed only by the readiness with which a man can operate an angle cock and performs a remarkably large number of different operations in forging, riveting, bending, welding, pressing and shaping of materials. The most complicated of these operations being accomplish in one heat.



Powerful Pneumatic Forging Machine—Illinois Central Railroad.



Powerful Pneumatic Forging Machine—Illinois Central Railroad.

This machine, which is an exact reproduction of a much smaller machine now in operation at these shops, has cylinders 24 x 31 ins. and will be operated with an air pressure of 125 lbs. From the engravings it will be seen that the frame consists of two heavy castings suitably fastened together to form a T-shaped bed-plate, on the longer arm of which is mounted longitudinally a 24-in. cylinder which furnishes power and motion to the hammer piston. The piston rod passes through both ends of the cylinder and on the driving end is a socket for receiving the stems of the male dies, while the other end projects far enough beyond the end of the cylinder so that when the piston is forced back to the beginning of the stroke, it will strike a lever which opens the exhaust valve, thus causing an automatic control of the exhaust. On opposite ends of the short arms of the frame are arranged adjustable die blocks which have a dovetailed and grooved connection with the bed plate and move at right angles to the hammer piston. These die-blocks are rectangular in form and are provided with rollers at the two inner corners, which come in contact with the metal as it is forced into the dies. The adjustment of these blocks is made independently toward and away from each other by means of screws working through plates bolted to the ends of the frame and engaging removable plates in the die-blocks at the other end. It is desirable in some classes of work, such as welding and forging, to have one of these die-blocks capable of use as a pneumatic hammer, which greatly increases the amount and character of the work performed. The construction of the dies is also made very simple by this arrangement, and they can be put into place and ready for operation in a very short time, as the dies for nearly all of the complicated operations simply lift in and out of the forms. To give power to the movable die an auxiliary cylinder 24 ins. in diameter is placed beneath the short arms of the frame of the

machine. In this cylinder is a piston, the rod of which is connected to the die-block on the farther end of the bed-plate by means of a lever. The pin of this connecting lever can be dropped into one of two holes in the die-block to give it suitable length of vibration. When air is let into the cylinder alternately on opposite sides of the piston the die-blocks will act as a hammer for delivering lateral blows.

The hammer piston and the die-holding piston can be operated either separately or in conjunction with each other, while the force of a blow or static pressure in either case can be controlled at will. These adjustments are made by the opening or closing of the cut-out cocks in the line of piping in front of which the operator stands. To strike a blow with the hammer, the lever valve just over the right-hand end of the cylinder is opened. This admits air from a reservoir suitably located under the frame of the machine, to the right end of the cylinder in such measure as the valve is opened; when the blow has been struck the valve is closed and the pressure remains on. By having previously set the cut-out cocks properly, in the smaller lines of piping the air in the cylinder will pass around to the other side of the piston and force it back to the power end of the cylinder. When the piston has arrived at the end of its return stroke the extension of the right-hand end of the piston rod will strike the trip lever, which in turn opens an exhaust exit to the air. The operation of the die-holding piston is made independently by the turning of an angle cock in the large and small lines of piping leading from the reservoir to the die-operating cylinder.

For such operations as safety straps for body truss rods and needle beam washers the die-blocks are screwed toward the center of the machine and form the sides of the female die, while the proper shaped male die on the piston arm bends the heated bar around loosely journaled rollers in the front corners of the die-blocks and forces it between the dies. In forming transom tie-bars, carry irons and work with four bends the operation is the same with the exception that the rollers are replaced by filling blocks, which give square shoulders to the die forms. In such work as center brake-lever carriers and draw-bar yokes a two-part die is inserted firmly between the two die blocks, which act in this case as a vise, and the bar operated on in three different positions. In forging swing-hanger bolts the side die is used as a pneumatic hammer which forms the bosses and heads by upsetting the metal from the bar, while the main hammer is held up to the work during the operation of the die-blocks. For riveting and welding the operations are simple and can be performed by the use of either hammer.

At a recent exhibition of this machine at the Burnside shops our representative noted the time required to change the dies for five different operations, which ranged from one to three minutes, the machine in all cases being ready for operation before the metal in the furnace could be brought to the proper heat.

We are indebted to Mr. M. Kennedy, foreman of the Illinois Central blacksmith shops, for the accompanying illustrations. Mr. M. Kennedy, the designer and perfector of this machine, has spent much time in making it the very complete and efficient blacksmithing tool that it is, and has had the hearty support of Mr. William Renshaw, superintendent of machinery of the Illinois Central, in the development and construction.

The absurdity of making thirteen steam joints in a blower pipe between the steam dome and the smokebox is immediately apparent when attention is directed to it. On an engine on one of the leading roads this number was counted and probably there were more which were concealed. This implies a large number and variety of fittings and suggests the importance of a standard of simple construction. There is an increasing tendency toward simplicity in piping and it is especially important in air brake apparatus where every angle and bend has its effect upon the rapidity of action, but much more remains to be done in this direction.

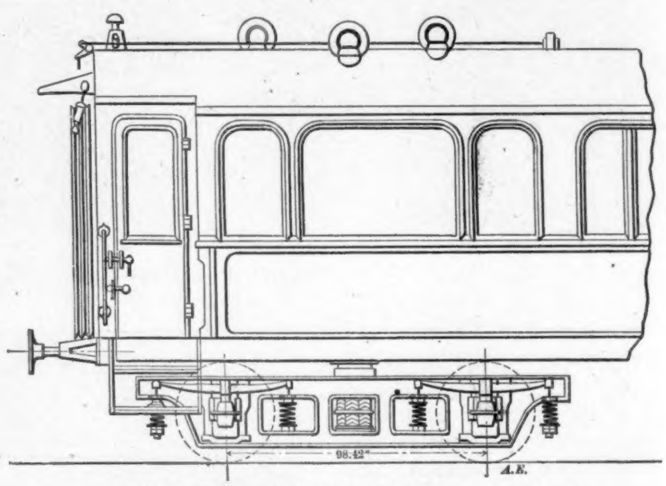
FOUR-WHEEL TRUCKS FOR HEAVY PASSENGER CARS.

A Suggestion from Swiss Practice.

If the present four-wheel passenger truck can be improved to give it the smooth riding qualities of the six-wheel truck it seems reasonable to believe that it will be used more extensively for heavy passenger cars and other heavy equipment, such as parlor cars, baggage, mail and express cars, smoking and sleeping cars. The shorter wheel base of the four-wheel trucks must be less destructive to the track and this type is unquestionably lighter and less expensive to maintain. The question is how to improve the riding qualities of the four-wheel truck.

Our attention has been directed to the arrangement of springs under passenger cars recently built for the St. Gotthard Railway, of Switzerland, and Mr. A. Christianson, of the motive power department of the Central Railroad of New Jersey, has kindly furnished a translation of a description of them, which recently appeared in the "Organ fur die Fortschritte des Eisenbahnwesens."

These cars are heavy and nearly correspond with the dimensions of American practice. They are 60 ft. long over vestibules; 9 ft. 6 in. wide, outside; 44 ft. 3 in. between the center of the



Four-Wheel Truck for Heavy Passenger Cars. St. Gotthard Railway.

trucks; the wheel base of the truck is 8 ft. 2½ in., and the car, when empty, weighs 72,730 lbs.

The engraving shows the arrangement of the springs from which it is seen that the equalizer, so prominent a member in American practice, has been omitted entirely, and the shocks are taken directly over the journal boxes by elliptic springs suspended at both ends by coil springs. This arrangement is attractive. It suggests the question whether the use of an equalizer in four-wheel trucks is justified. Does it serve as an equalizer for the load or as a reducer of shocks? Does it not simply transfer the shocks through the equalizer spring to the wheel-beam nearer to the center of the truck? In this way the shocks are apparently reduced, but as the distance from the equalizer spring to the center of the truck is reduced the shock actually remains the same as if taken up by the wheel-beam directly over the journal. The equalizer may even be detrimental because it acts as an inert mass with its weight resting directly on the journal without the cushioning effect of a spring and it therefore must increase the wear of the bearing.

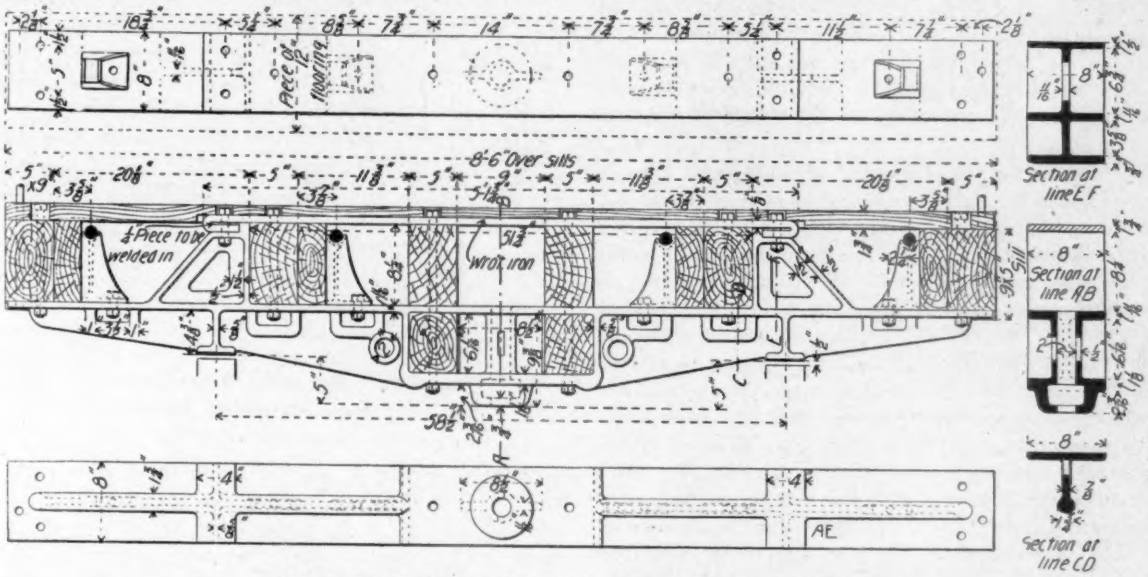
If the equalizer is absent, the wheel-beam must be strengthened in proportion to the increase of leverage due to moving the springs outward to points over the centers of the journals. If this is done and a better form of spring, the half elliptic, is substituted for the usual coil spring in such a way as is outlined in the engraving, the riding qualities of the truck should be equal to if not superior to those of six-wheel trucks.

CAST STEEL BODY BOLSTER.

Chicago, Rock Island & Pacific Railway.

The accompanying engraving illustrates a cast steel body bolster designed and patented by Mr. G. A. Akerlind, Chief Draftsman of the Chicago, Rock Island & Pacific Railway, to take the place of wrought-iron bolsters formerly used on that road. This bolster is very strong and comparatively light, weighing but 416 pounds complete.

The problem was to make provision for the draft-timbers to pass through the center and at the same time use as few parts as possible and give them sufficient strength to keep the car off of its side bearings. It will be seen that the number of parts is reduced to a minimum, there being but six pieces in all, including the four truss rod brackets, which are separate castings bolted to the main casting with ¾-in. bolts, and resting against the inner faces of the filling blocks which are interposed between the outside and intermediate sills and these brackets. This bolster is used for 60,000-lb. box and stock cars of the Rock Island road, also the same design is used on 80,000-lb. coal cars with a little different arrangement of side sills, which are, in the case of the coal cars, much deeper than the center and intermediate sills.



Cast Steel Body Bolster with Removable Tension Member. Chicago, Rock Island & Pacific Railway.

From the engraving it will be seen that the sills all bear on a substantial main casting which allows a wide arrangement of these sills. Sections through the bolster are given to the right in the engraving, in which section E, F, shows the form of the lower-webbed portion, and the open spaces 3½ by 1¼ in. cored in the web for convenience in getting at the nuts of the bolts which fasten the sills and truss rod brackets; A, B, shows the form of the upper center plate which is integral with the bolster and C, D, which is a section taken through the part forming the upper side bearing. Two 2-in. openings are also provided for the air-brake pipes.

The tension member is an 8 by ¾-in. wrought-iron plate 59¼ in. in length with 3¾ in. bent down at each end in such a manner as to form a square bearing surface with two 1¼ by 8-in. lugs cast on the body of the bolster not less than 51¾ in. apart. The space between the bent down ends of the tension member has a ¼-in. filling piece welded in. This tension member, which is given a driving fit, is fastened by four ¾-in. bolts, two at each end, and it may be removed and the bolster taken down, when necessary, without removing the end sill of the car.

This bolster was originally intended to be of malleable iron, and some trouble was experienced from breakages originating from hidden cracks in the metal. The whole trouble was due to the fact that the castings were not malleable, as was supposed, but ordinary gray iron. Steel has been used exclusively for the past three years and the bolster has during this period of service been satisfactory in every way and they have given no sign of breakage. These bolsters are being applied to all of the new cars of the three classes mentioned. They are made by the American Steel Foundry Company, of St. Louis.

HOT WATER HEATING IN INDUSTRIAL WORKS.

So long as the exhaust steam is used as the agent of heat distribution, it does not appear that there is any practicable way in which the heat of the exhaust flue gases can be applied to the same system. The temperature of the exhaust steam is at least 212 degrees, so that it can absorb heat from the flue gases at only a very slow rate. Moreover, the steam has only a small capacity to absorb heat, unless raised to a very high pressure, which would be prohibitive. Water, on the other hand, may be easily raised to nearly 212 degrees by exhaust steam at the pressure of the air, and the flue gases may be subsequently used to push it materially above this figure if desired. As the flue gases are much hotter than the exhaust steam, though the total heat units which they can give up are only a fraction of those in the steam, it will usually be more convenient, for general heating purposes, to give the circulating water somewhat less than 212 degrees by the exhaust and then to reach or go slightly beyond this figure through the application of flue gases.

While in heat distribution by exhaust steam its minimum temperature is usually 212 degrees, in distribution by hot water the lowest working temperature must be much less than this figure. A limit is soon reached, however, for the reduction in temperature of the circulating water, because of the consequent decrease in the value of radiating surface. Just how low the temperature of the circulating water should be permitted to go depends somewhat on local requirements, but a drop of about 61 degrees from 212 can be permitted in many cases. With this change of temperature, each pound of water gives up 61 heat units, so that 1 cu. ft. of water, weighing 60 lbs. at about 212 degrees, offers an available storage capacity of 3,660 heat units. A cubic foot of steam was found to have a storage capacity in its latent heat of 36.6 units, or only 1 per cent. of that offered by the hot water of equal bulk.—A. D. Adams, in Cassier's Magazine for August.

WHAT IS THE IDEAL FAST PASSENGER ENGINE?

The comparative merits of the American or 8-wheel, the Atlantic, Columbia and Atlantic types for fast passenger service were considered by Mr. S. M. Prince, Jr., Superintendent of Motive Power of the Philadelphia & Reading in the "Railroad Gazette," June 22, 1900, page 412, in an interesting and timely article.

Mr. Prince is no stranger to the Columbia type, having outlined such a wheel arrangement in 1882. He soon after came to the conclusion that "the only true high-speed engine would be one with a wide or Wootten firebox and large driving wheels placed under the firebox, or, in other words, an American type engine raised sufficiently high to accommodate the size of driving wheels."

This idea he worked out in a design of an 8-wheel engine with a wide firebox and 78-in. driving wheels under it, and even with wheels of this size the center of the boiler is but 9 ft. 2⅝ in. above the rails. This engine was rebuilt, using an old boiler, and Mr. Prince says that in building an entirely new engine the wheels could be 84 in. in diameter with the same length of boiler.

He believes this to be the ideal type of high-speed passenger locomotive and when it is necessary to secure higher capacity than may be carried on 8 wheels; he would add 2 driving wheels instead of trailers. The conditions as to right wheel base are practically the same in both cases, and the 10-wheel type has the advantage of using the weight on the rear wheels for traction. Mr. Prince holds that nothing can be said in favor of the Columbia or Atlantic that cannot be said of the 10-wheel type, and he believes that nothing has been accomplished by the Columbia and Atlantic that cannot be more satisfactorily accomplished by the 8-wheel and 10-wheel types. He describes an 8-wheel engine, outlined by him several years ago, with 84-in. driving wheels and the center of the boiler 9 ft. 3 in. above the rails. The height of the boiler in any of these types was determined by the size and location of the cylindrical part with reference to the driving wheels. In recent Atlantic type engines the boilers were as high as this and Mr. Prince raises the question why they were not of the 8-wheel type.

These opinions are very valuable coming from a man of Mr. Prince's experience, and his opinion as to the 10-wheel type will find favor in many directions, especially among those having the problem of 13 (and more) cars which must be handled on uncomfortably fast schedules. This question of type, however, needs to be very carefully stated or the arguments may be misleading. It is one thing to design a 10-wheel passenger engine with 70-in. driving wheels and a wide firebox for anthracite coal and quite another thing to adapt this type and 84-in. drivers to a bituminous coal engine with such a grate area as it ought to have. We would like to see how Mr. Prince would treat the 84-in. driver engine of the 10-wheel type for soft coal, giving the grates sufficient area to burn it in accordance with the ideas which are now so prominent in the minds of those who are trying to get away from very narrow fireboxes. Perhaps he would not insist on a deep-throat sheet and perhaps he would not be unwilling to raise the boiler high enough to get the rear drivers of a 10-wheel arrangement under the firebox. This appears to be the vital question in fast passenger engine design now: How to get a wide firebox for bituminous coal over large driving wheels?

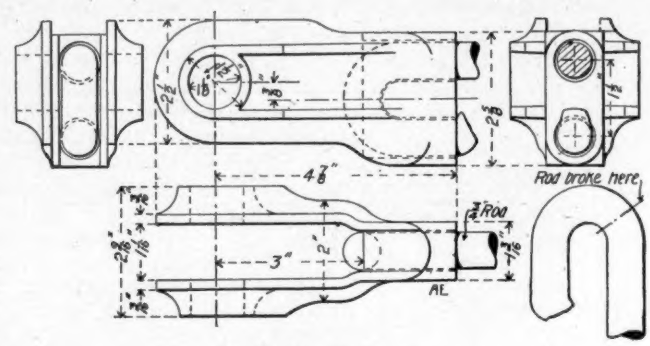
We should say that the 8-wheel type is best where it can be used; that the Atlantic type is the next step to be taken in order to get more heating surface than can be carried on 8 wheels and that the 10-wheel type comes in when the trains are both fast and heavy, too heavy for the Atlantic type to start. There seems to be a distinct field for the Atlantic type, between the 8-wheel and 10-wheel types, for specially fast and relatively light trains, such as the Atlantic City service and in similar work. The 10-wheel type is believed to be the one to be studied most by roads having heavy trains and burning soft and relatively poor coals, because it is here that the limitations of the fireman are confronted and this is rapidly taking position as an exceedingly important difficulty.

MALLEABLE IRON BRAKE JAWS.

Pere Marquette Railroad.

Referring to the test comparing the strength of malleable and wrought-iron jaws recorded on page 255 of our August number, Mr. B. Haskell, Superintendent Motive Power of the Pere Marquette, sends us a drawing of the malleable iron brake jaw extensively used on that system with exceedingly satisfactory results. The form of the jaw and the method of attachment of the rod are admirable and the test records show a remarkable and unexpected strength of malleable iron for this service.

Mr. Haskell also sends a letter written to him by Mr. Robert S. Cox, formerly General Manager of the Terre Haute Car and Manufacturing Co., upon the subject. This firm was building



Malleable Brake Jaw.
Pere Marquette Railroad.

cars for this road at the time, and these jaws were specified. The question of the strength of the jaws was raised and in December, 1898, Mr. Cox, without the knowledge of Mr. Haskell, submitted them to the Rose Polytechnic Institute for test. The results are interesting, and the strength shown by the malleable iron was a surprise to those who had questioned it. Mr. Haskell has used these jaws four years and has never found one of them broken. Some have been distorted in wrecks, but there has never been a failure in service. The letter by Mr. Cox describes the tests as follows:

"It will probably interest you to learn of some experiments that we made on one of your ¾-in. malleable brake jaw castings at the Rose Polytechnic Institute yesterday.

"The jaw was fitted with a ¾-in. iron rod and with a stub end of a lever fitted in the ends between the jaws. It was then put in a Rhiele testing machine and the pulling strain applied. The iron rod broke at 22,500 lbs. A bar of crucible steel was then applied in place of the ¾-in. iron and the jaw again submitted to the pull of the machine. This crucible steel broke at 35,100 lbs. strain and we were unable to find anything sufficiently strong to hold the jaw to the breaking point of the casting.

"At the conclusion of these tests, the jaw was apparently in as good condition as at first, with the exception that the holes for the pin were slightly elongated but not sufficiently to cause any difficulty in removing the pin. Both the iron and the crucible steel rods broke at the point indicated in sketch."

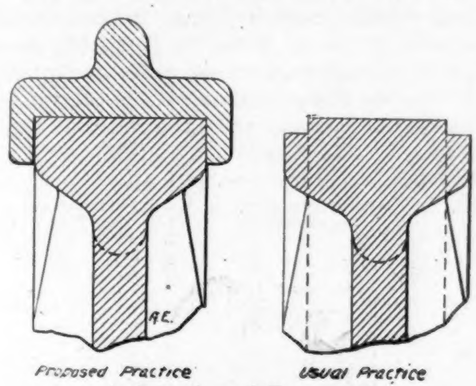
A recent test of a 600 horse-power "Simplex" gas engine at Seraing, Belgium, with high furnace gas gave the following results, as recorded in "The Engineer," London, June 29, 1900, page 662:

Brake horse power	573
Indicated horse power	790
Revolutions per minute	94
Number of admissions per minute	42
Mechanical efficiency, per cent	72
Gas per I. H. P. hour, cubic feet	89.3
Gas per B. H. P. hour, cubic feet	123.7
Heat value of gas in B. T. U. per cubic foot by Junker's calorimeter	102.4

LUBRICATION OF ECCENTRICS.

A good suggestion with reference to the form of locomotive eccentrics and eccentric straps, by Mr. F. W. Dean in an article in the "Railway Age" of June 15, attracted our attention as being worthy of trial because of the anxiety caused on some roads by hot eccentrics. We quote Mr. Dean as follows:

"Hot boxes in locomotive axles and pins seem to be as common as ever. Except in the case of foreign substances getting on the bearing surfaces, this is caused by defects in methods of lubrication. If a bearing is flooded with oil and the oil is actually on the bearing, hot boxes are impossible. The designs of eccentrics and straps, and of crankpins I have long held to be radically wrong. They are now made so that the centrifugal force carries the oil away from the bearing in the case of crankpins and sometimes in the case of eccentrics. The design of eccentrics also is such that three surfaces have to be fitted and taken care of. Where the eccentric is recessed into the strap



Lubrication of Eccentrics.

the centrifugal force keeps the oil on the main part of the bearing away from the other parts. If the side bearings were omitted and the strap overhung the sides of the eccentric, the eccentric would work better. Similarly, if crankpins were designed so that the bearing part of the box was on a larger diameter than the remainder of the pin; in other words, if the box clasped the pin to prevent side motion instead of the pin clasping the box, the centrifugal force would keep the oil where it is needed. This would make large pins, but they could have large holes through them and reduce weight in that way. In the case of driving axle journals it seems as if forced lubrication and filtration of oil, arranged so that it can be used again, would cure the difficulty."

Upon inquiry we find that Mr. Dean does not know of this form of eccentric and strap having been used on locomotives or in stationary work, except in the case of a stationary engine designed by him some years ago for use in South America and certain engines which he designed for mill work. It seems to us to be a very sensible way to construct eccentrics. We reproduce a free-hand sketch sent us by Mr. Dean.

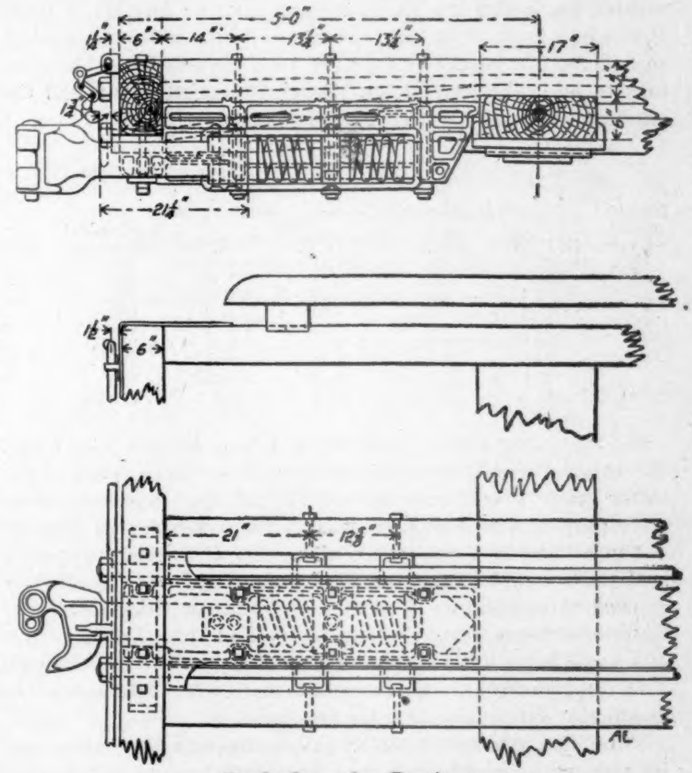
The number of railways in the hands of receivers on June 30, 1899, was 71, there being a net decrease of 23 as compared with the corresponding date of the previous year. According to the Interstate Commerce Commission reports the number of railways placed in charge of receivers during the year was 16, and the number removed from their management was 39. The operated mileage of the roads under receivers on June 30, 1899, was 9,853.13 miles, of which 7,225.62 miles were owned by them. Of the roads in the hands of receivers on the date named 10 had an operated mileage in excess of 300 miles, 10 between 100 and 300 miles, and 40 less than 100 miles. Complete returns for roads in the custody of the courts are not always available, but it appears that the capital stock represented by railways under receiverships on June 30, 1899, was about $220,210,688; funded debt, $306,486,740, and current liabilities, $59,180,823. These figures show a decrease of $43,926,703 in capital stock represented as compared with the previous year, and of $16,405,951 in funded debt.

TENDER DRAFT GEAR.

Louisville & Nashville Railroad.

Draft gear of tenders now receives more attention than was necessary when train loads were lighter, and many roads are considering the use of stronger forms. This arrangement, designed by Mr. Pulaski Leeds and Mr. F. A. Beckert, is illustrated as an example, showing that tender draft gear needs to be strengthened rather than because it is novel.

This drawing illustrates the recently adopted standard of this road. It replaces the simple and common arrangement employing a draft casting held to the end sill by the draft rods and including a Gould or Curtis M. C. B. coupler head. The new draft gear is like the M. C. B. arrangement except that it has tandem springs. It is similar to the draft gear of the 80,000-lbs. furniture and flat cars of this road. Mr. Beckert says that when applied to tenders the effect of the



Draft Gear for Tenders. Louisville & Nashville Railroad.

draft gear upon the shocks and strains on the end structures of the cars nearest the engine is very marked. It also shows at once a tendency to reduce the trouble from breaking in two when the slack of the train runs out in going over summits. The jerks are cushioned by the springs instead of coming upon the tender frame through rigid couplings. A lateral motion of the draw-bar amounting to 2 in. is provided for in this gear. This motion is beneficial on curves and it should be provided to a proper extent in all couplings. This arrangement includes malleable iron draft castings which are designed to distribute the stresses upon the tender frame in such a way as to reduce the wear and tear to a minimum. The uncoupling device is the same as that employed in freight equipment.

Recent tests made of the electrolytic condition of the four great cables which support the Brooklyn Bridge disclosed the following facts: That these cables are great live wires through which currents of electricity are irregularly flowing, and that these currents are escaping to the ground through the eight heavy anchor-plates which are being eaten away slowly by this process of electrolysis.

TEST OF GAS ENGINE AT DIFFERENT LOADS.

Gas engines are not often tested at different loads, therefore the results of tests made by Mr. H. A. Soverhill, at the University of Illinois, and printed by "The Engineering Record" of July 21, are specially interesting.

The engine is the ordinary type of 10 horse-power, built by the Otto Gas Engine Company, of Philadelphia. It has a 5½x 12½ in. cylinder and runs at 310 revolutions per minute, the governing being by the "hit or miss" method. Careful arrangements for measuring the gasoline and securing other data were made and the temperature of the cooling water was taken by thermometers. A prony brake was used in determining the brake horse-power. The brake arm was proportioned in such a way as to lessen the work of computation by using the formula B. H. P. $= 2\pi lwn \div 33{,}000$, in which $\pi = 3.1416$, $l =$ length of brake arm, $w =$ weight or pull on arm, and $n =$ number of revolutions, and finding the value of l that will cause $2\pi l \div 33$ to drop out. This value was found to be 63.025 inches. By making the brake arm 63.025 inches long, the formula is B. H. P. $= wn \div 1{,}000$. The rear end of the brake is weighted so as to balance the weight of the arm, thus causing the scale readings to be brake load direct. Several tests were run **and the** readings given in the accompanying table were taken:

Tests of an Otto Gas Engine at Different Loads.

Length of test —hours.	R. P. M.	Explosions per min.	I. H. P.	B. H. P.	Mechanical Efficiency.	Gasoline per hour. per I. H. P.	Gasoline per hour. per B. H. P.	Jacket water. Degrees Fahr. In.	Jacket water. Degrees Fahr. Out.	Jacket water. Lbs per I. H. P. per hr.	Jacket water. Lbs. per B. H. P. per hr.	Brake load lbs.
1½	312	25	2.11	0	0	.622	....	90.5	160	....	...	..
1	311	49.6	4.21	1.56	37%	.54	1.46	78.8	167.5	....	...	5
1	313.6	58	4.99	2.27	45%	.66	1.43	64.4	159	84.1	185	7
1	310.9	76.5	6.72	4.04	60%	.567	.94	69.2	128	...	...	13
2	310	91	7.13	4.64	65%	.69	1.06	60.5	167	....	...	15
1	306	103.3	8.64	6.73	75.9%	.58	.748	68.4	199	45	35	22
1¾	308	132.3	10.57	8.30	78.5%	.64	.82	55.5	175	62.5	49	27
1	309.3	119	11.18	9.27	83%	.545	.647	54.6	157.5	63	52	30
1½	307	148.3	12.15	10.5	86.56%	.54	.64	63.6	118.5	....	...	..

In conducting a test from which a heat balance was made, the exhaust gases were passed through a Baragwanath feed-water heater placed in a horizontal position. When the gases enter they expand nearly to atmospheric pressure, pass through the tubes and give up heat to the water at constant pressure. The thermometer placed in the exhaust pipe near the heater showed a temperature slightly above that of the water. The water was taken from the city mains and throttled by means of a globe valve until about the desired amount flowed through. The temperatures at entrance and exit were taken and the amount of water passed through weighed.

From the amount of water passed through the heater and its rise in temperature, it was found after correcting for the difference between the temperature of the atmospheric air and that of exhaust that 14,125 B. T. U. passed out through the exhaust during the test. There were 297.2 pounds of water used in the cylinder jacket and it was raised 103.1 degrees in temperature; that is, $297.2 \times 103.1 = 30{,}646.8$ B. T. U. carried away by engine jacket.

The brake horse-power was 9.27, which equals $9.27 \times 33{,}000 \times 30 \div 778 = 11{,}802$ B. T. U. The amount of energy consumed by friction was found by subtracting B. H. P. from I. H. P. and was found to be 2,687.4 B. T. U. A sample of the gasoline used was tested for its calorific value and was found to contain 17,200 B. T. U. per pound or $17{,}200 \times 3.94 = 67{,}778$ B. T. U. supplied during the test. This energy was distributed as follows:

	B. T. U.	Per cent.
Useful work	11,802	17.41
Friction of engine	2,687.4	3.96
Exhaust	14,125.2	20.98
Jacket water	30,600	45.15
Radiation, etc.	......	12.51
Total supplied		100.00

Mr. W. W. White, Air-brake Inspector of the Michigan Central, has resigned to accept a position with the International Correspondence Schools, and will have charge of instruction car No. 106.

THE MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION.

This association will hold its thirty-first annual convention at Detroit, Mich., for four days, beginning September 11, with headquarters at the Cadillac Hotel. The following subjects will be presented:

"Hygene: Its Costs and Compensation." Dr. P. G. Conn.

"The Best Method of Conducting Tests to Determine the Relative Merits of Various Materials Used in Painting Railroad Equipment," F. S. Ball, Pennsylvania R. R., Altoona, Pa.; C. E. Copp, Boston & Maine R. R., Lawrence, Mass.

"The Best Method of Painting Locomotives; Also the Proper Method of Keeping Paint on Locomotives in Good Condition," Chris. Clark, New York, Chicago & St. Louis Ry., Chicago, Ill.; W. M. Joyce, Baldwin Locomotive Works, Philadelphia, Pa.; C. A. Cook, Philadelphia, Wilmington & Baltimore R. R., Wilmington, Del.

"The Best Method and Material for the Hardwood Surface of the Car Interior," Chas. E. Koons, St. Louis Car Co., St. Louis, Mo.; John T. McCracken, Jackson & Sharp Co., Wilmington, Del.; C. A. Bruyere, Canada Atlantic R. R., Ottawa, Ont.

"The Railway Master Car and Locomotive Painter," Samuel Brown, New York, New Haven & Hartford R. R., Boston, Mass.

"Is Terminal Cleaning, Where Thoroughly Practiced, a Factor in Paint Shop Economy?" J. A. Gohen, Cleveland, Cincinnati, Chicago & St. Louis R. R., Indianapolis, Ind.; B. E. Miller, Lehigh Valley R. R., Scranton, Pa.; A. R. Lynch, Pittsburgh, Cincinnati, Chicago & St. Louis R. R., Dennison, O.

"Can a New Wood Head Lining Be Prepared so as to Prevent Decay of Filler, Grain Raising, Etc.? If so, Give Method of Preparation," E. A. Cole, J. G. Brill Car Co., Philadelphia, Pa.; W. H. Dutton, Lehigh Valley R. R., Sayre, Pa.

"Does Burning Off Old Paint Have an Injurious Effect Upon the Surface or Upon the Future Painting?" Henry Block, Cleveland, Cincinnati, Chicago & St. Louis R. R., Brightwood, Ind.; J. A. P. Glass, Yazoo & Mississippi Valley R. R., Vicksburg, Miss.; Robert Shore, Lake Shore & Michigan Southern R. R., Cleveland, O.

"Uniform System of Freight Car Stenciling," J. H. Kahler, Erie R. R., Meadville, Pa.; W. O. Quest, Pittsburgh & Lake Erie R. R., McKees Rocks, Pa.; R. W. Scott, Seaboard Air Line R. R., Portsmouth, Va.

"Paint Shop Records and Accounts," W. T. Canan, Pennsylvania R. R., Tyrone, Pa.; F. G. Schaefer, Wheeling & Lake Erie R. R., Toledo, O.

Various queries.

That there is any advantage in facing locomotives in any particular direction in the erecting shop has probably not occurred to many of our readers, and because it seems to be a very sensible suggestion attention is directed especially to Mr. Whyte's remarks (June, 1900, page 188) about the position of engines in the erecting shop with reference to the windows. The front end of the engine should be toward the best light. This brings the smokebox, the cylinders and running gear into the most favorable position for light. The firebox end is toward the light in many shops, but as it is always necessary to use artificial light for interior firebox repairs, natural light at that end is not so important. This is one of the small details of shop arrangement which is often overlooked and is appreciated at once when attention is called to it.

FRICTION AND SPRING DRAFT GEAR.

Graphical Comparison of Absorbing Capacity.

The necessity for providing increased capacity in draft gear for the absorption of energy is becoming more apparent as the weights of cars and trains increase, and one of the features of recent discussions of draft gear is an apparent appreciation of the deficiency of ordinary draft devices in this respect. We have already directed attention to the Westinghouse friction draft gear, and to its great power-absorbing capacity with absence of recoil, but have not been able to show this graphically until the accompanying diagram was received from the manufacturers of this draft gear.

This diagram shows the relative capacities of the ordinary draft spring (20,000 lbs. capacity) and the Westinghouse friction draft gear to absorb and dissipate buffing and pulling effects. It also shows the reactive effects of each.

The rising line, BB'A, represents the action of the Westinghouse gear under pulling or buffing stress, starting at an initial compression of about 2,000 lbs., as shown at the left of the diagram, and rising to a maximum stress of 142,000 lbs. The total area, BACB, represents the work done in arresting the buffing or pulling stress, while the lightly shaded area represents the amount of energy dissipated as heat by the frictional gear. The shaded portion is in this instance found to be 80 per cent. of the total area, BACB, only 20 per cent. of

Combination of Friction and Ordina y Draft Gear.

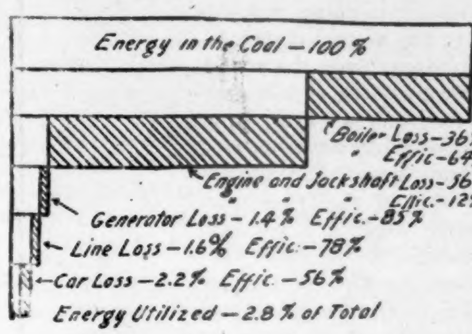
the energy of impact being given back in recoil as shown by the non-shaded portion of the area BACB.

The straight line DE represents the operation of an ordinary spring gear starting from zero compression. The area DEC represents the work done upon the spring during compression, and the narrow, heavily shaded area DE represents the amount of energy dissipated in frictional heating by the spring. In this instance the proportion of energy dissipated is only 7 per cent., as against 80 per cent. of the total energy in the case of the Westinghouse gear.

The diagram also shows in a very striking manner the maximum capacities of the two types of gear, the ordinary gear being shown at its maximum of 20,000 lbs., while the capacity of the Westinghouse gear is not exhausted until a compression of 140,000 lbs. and over has been reached.

SURPRISINGLY LOW EFFICIENCY OF ELECTRIC STREET CARS.

A series of tests of electric street cars in Ithaca, N. Y., was recently reported in the "Street Railway Review," by Mr. E. L. West. One of the interesting diagrams is reproduced in this engraving. It shows the distribution of energy for the entire system, giving the proportional parts of the total losses. The energy of the coal is taken at 100 per cent. and the sec-



Efficiency of Electric Street Cars.

tional portions of the diagram represent the various losses. At the right of each sectioned block are given the loss in per cent. of the total energy and the efficiency of that part of the system. The energy utilized in propelling the car under average working conditions is 2.8 per cent. of the total energy of the coal. The experiments were conducted under the direction of Prof. R. C. Carpenter of Cornell University.

F. W. DEAN ON LAPPED LONGITUDINAL BOILER SEAMS.

The practice of lapping plates of locomotive boilers for the longitudinal seams is strongly condemned by Mr. F. W. Dean in an article on locomotive progress in a recent issue of "The Railway Age." Mr. Dean speaks from a wide experience in designing large boilers and supports the view we take, that practice which is not correct in theory should be avoided unless there are the best of reasons for setting aside theoretical views.

"If anybody will make a study of boiler explosions," says Mr. Dean, "where the shell has been the initial part to rupture, or of boilers that have had cracks in the shell joints but have not yet exploded, he will be convinced that the lap joints are the causes of the explosions. I take every opportunity to reiterate this view. The lap joint with a bent inside covering plate is but little better, for it merely prolongs the life of the boiler a short time. The reason for this view of the case is that a lap joint necessarily throws the shell out of the circular form and causes the plate to bend at the edge of the joint with every change of pressure and finally wrecks it there. Everybody knows that if a wire or plate is bent back and forth in the fingers it will finally break off."

If there is no good reason for using lap joints, and we cannot now think of any, this view certainly ought to be considered by those using them.

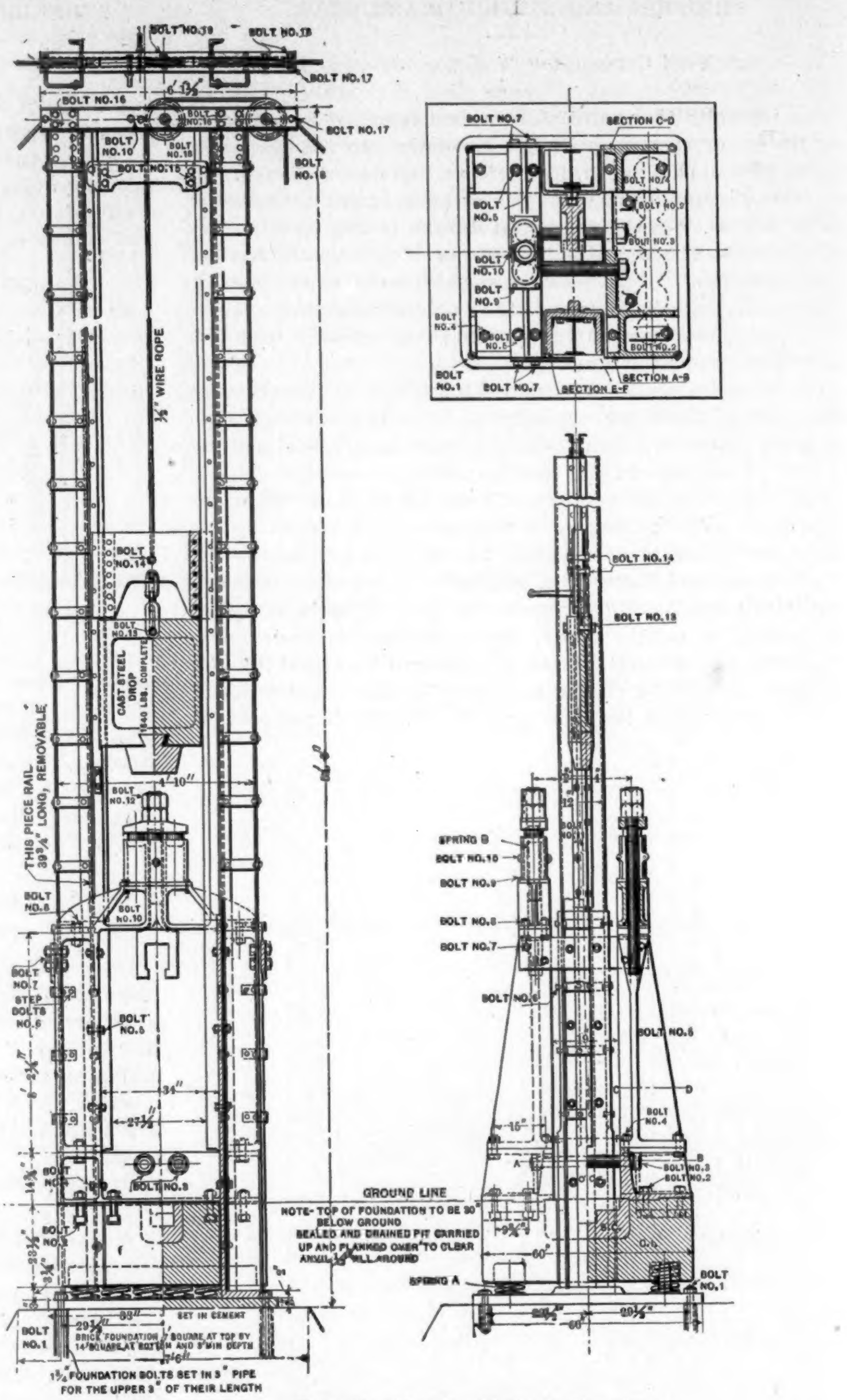
A milling cutter exhibited at Paris by the Eastern Railway of France has made a good record which is noted in the "American Machinist." The dimensions of the cutter are ¾ in. pitch, 9 13/16 in. diameter and 15¾ in. long. Beside the cutter is a box of chips cut by it in ten minutes from mild steel. The chips are all alike, the full length of the cutter, rolled up like straws and their weight is given as 15.4 lbs., which is at the rate of 92.4 lbs. per hour. The depth of the cut was 9/16 in., the feed 9/16 in. per minute and the circumferential speed of the cutter 32.8 ft. per minute. It is used in locomotive work.

M. C. B. ASSOCIATION DROP-TESTING MACHINE FOR COUPLERS.

As we have already noted, the Master Car Builders' Association committee on tests of M. C. B. couplers included in their report this year a thoroughly developed design for a drop-testing machine, which is illustrated by the accompanying engraving reproduced from the report.

After the convention of 1899 Purdue University, through Prof. R. A. Smart, with the approval of the late President Smart, and subject to the approval of the trustees of the University, made a proposition to the committee to the effect that a drop-testing machine of the approved design should be constructed by the University at its own expense under the direction of the association, and that when built it should be the property of the University and installed in its laboratory, to be at all times subject to the use of the association for official research. The University agreed to furnish the necessary assistance for carrying on tests, the machine to be at all times available for educational or commercial purposes. This, in short, is an arrangement similar to those under which the M. C. B. brake-shoe and airbrake testing apparatus have been installed in the laboratory, except that in this case the testing machine will be the property of the University.

This plan has been perfected and the testing machine is to be built. We reproduce the general plans in order to inform our readers of its chief features which are made clear in the engraving.



Recommended Drop Test Machine f r M. C. B. Couplers.

The new Hamburg-American liner "Deutschland" has again broken all previous records by making the voyage from New York to Plymouth at an average speed of 23.22 knots, the trip occupying 5 days, 11 hours, 43 minutes. She arrived at Plymouth August 14, and the speed is phenomenal considering that it was done on the second round trip.

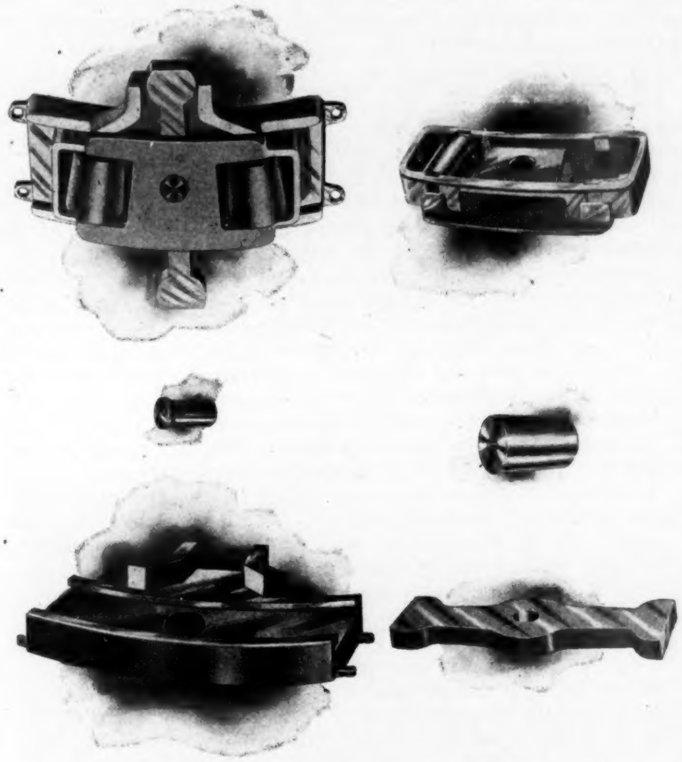
From a number of very carefully kept records of the weight of steel required for the skeleton of the average office building, the following formula was deduced, $W = N.F. (15 + 7/10\ N)$, in which W is equal to the total weight of metal in pounds, N the number of floors in the building, with the roof considered as a floor, and F the square feet in each floor. Then to find the weight of beams and fittings required in the floors we multiply 15 by the factor N.F and for the weight of columns multiply 7/10 N by the same factor. The sum of these weights is equal to W. This formula is offered as being sufficiently accurate for preliminary estimates on the weight of steel skeletons for an average building. It is taken from a paper by Mr. F. H. Kindl before the American Institute of Architects.

The J. G. Brill Co., Philadelphia, have won an important suit affecting their patents, the proceedings having been instituted against the Third Avenue Railroad of New York for the use, by this road, of a number of trucks employing spiral and elliptic springs, which were made by the Bemis Car Box Company, known as its "Standard" truck. The suit was vigorously defended by the Bemis Company, and after three years' litigation the decision, just handed down by Judge Shipman, sustained the validity of the claims of the Brill Company, and decreed, with costs, an injunction against the infringement of all of the claims and an accounting of profits and damages. The opinion contains the following: "The gist of the invention consists in combining with the frames of the truck and the spiral springs, another class of springs, viz.: elliptical springs, between the car body and extensions of the independent frame." The Brill Company intend to protect their rights in their claims and knowledge of the decision should prevent further infringement. We understand the decision to cover an arrangement of spiral and elliptical springs placed on the outer end of the truck frame.

THE IMPROVED SUSEMIHL ROLLER SIDE BEARING.

Improvements in roller side bearings for cars are particularly interesting at this time because the necessity of reducing flange wear and flange resistance is more thoroughly appreciated resulting from the increasing weights of cars and loads. In a previous issue of this journal the earlier form of this side bearing was illustrated, and we now present engravings showing an improved form of the bearing complete and in detail. The engravings are sufficiently clear to require little description. This is a development from 15 years experimenting, one idea of the inventor and designer being that it was necessary to provide means for compelling the rollers to roll and bring them back to their proper position between the bearings even when unloaded. The tendency for rollers to flatten unless compelled to roll is well understood.

There are but five parts to this bearing in addition to the



The Improved Susemihl Roller Side Bearing.

upper and lower bearing plates, which must be provided in any side bearing. The carriage is a simple malleable casting, which confines the rollers, and, in conjunction with the lever, compels them to roll, always returning them to their central position even when the bearings are out of contact. This is done positively and without dependence upon springs. The lever is also of malleable iron; one end extends into a bracket projecting upward from the lower bearing plate and the other end into a bracket projecting downward from the upper bearing. Any change of position between the body and truck bolsters must, therefore, compel a corresponding motion of the carriage and consequently also of the rollers. The pin forming the connection between the lever and the carriage cannot be taken out until the upper bearing has been removed from the bolster. The rollers are about 2½ in. in diameter and 3 in. long; they are made of chilled iron. The bearing plates are also of chilled iron. If the car is jacked up or becomes separated from the truck, all the parts remain with the upper bearing and can not fall out or get out of place. This roller bearing is manufactured and sold by the Simplex Railway Appliance Company, Fisher Building, Chicago, from whom further information may be obtained.

TRANSPORTATION AT LOW COST.

American Pressed Steel Car Industry.

Reprinted from the Paris "Figaro."

It is a great mistake, common to all superficial minds, to think that all the progress which has been or may yet be made in the railroad industry must be limited exclusively to increasing the speed of trains and the comfort of passenger cars. Another improvement which is equally important, for it affects the vital interests of the entire human race, is the reduction to a minimum of the cost of transportation, and particularly of goods such as coal and ore, the circulation of which is to the industries of modern civilization what the flow of blood is to animal life.

In this matter it is safe to say that the record is indisputably held by the United States—the country of the whole world where railroad transportation is worked at the lowest cost. It is indeed in a great measure to this fact that the Americans owe the greater part of their formidable and increasing economical power.

The low cost of transportation naturally suggests a number of various contributing factors, such as the increase of the tractive power of locomotives, the improvement of the roads, etc. But among these faculties the one which appears to play the most important part is without question the increase of the capacity of the cars. It naturally stands to reason that the larger the cars the more goods they can carry, from which the following advantages result:

First.—Increased paying load in all trains.

Second.—Reduced number of cars in use, and reduced empty car movement; consequently a reduction in the capital engaged.

Third.—Shorter trains for a given tonnage, therefore increased paying load hauled by each locomotive.

Fourth.—Reduced switching service and cost of staff.

Fifth.—Increased capacity of main lines, stations and shops, which can accommodate a larger traffic without any enlargements.

Sixth.—The available capacity of a permanent way is utilized to a fuller extent.

However, the solution of the problem is not as easy as it might seem; one cannot go on increasing indefinitely the capacity of cars without at the same time increasing their dead weight in the same proportion. Ten years ago it was believed by engineers that the limit of the capacity of freight cars was reached in the wooden cars of 27,000 kilogrammes capacity, and many cars were still built of smaller capacity. But it was only an optical illusion. At the present time there are a large number of coal cars in use of 36,000 kilogrammes capacity, there are also many thousands with a capacity of not less than 45,000 or 50,000 kilogrammes.

It has been a complete revolution, which one may say has been brought about by one man, Mr. Charles T. Schoen, President of the Pressed Steel Car Company, to whom all the credit is due. Starting with the principle that the ideal object should be to transport the heaviest possible loads with the smallest possible dead weight, Mr. Schoen realized that to attain this object everything depended upon the selection of materials, and he decided to build cars entirely of pressed steel. The undertaking was not a light one, but owing to the mathematical precision of the designs, the principle of construction being to secure such a disposition of material that every part is proportioned to the service required of it, combining strength and lightness and avoiding the use of rivets and corner pieces.

Mr. Schoen has succeeded in building cars of an average capacity of 43 tons in which the ratio of dead weight to the total weight is 25 per cent. instead of from 35 to 50 per cent., as was the case previously. In a 45-ton car the saving in dead weight thus effected is at least 2,200 kilogrammes. Everybody will readily grasp the importance of this saving, as it requires the same tractive force and the same expenses to handle a dead weight as a paying load.

The majority of American railroads—not to speak of others—have adopted pressed steel cars, as in addition to the commercial advantages already mentioned their construction is much simpler, stronger and more lasting, and less costly to keep in repair. On the 1st of June last there were 18,038 of various

patterns in use, by the 1st of September next there will be 24,-138; but the number of pressed steel cars already ordered is at present 26,412, of an average weight of 15,000 kilogrammes and of a total capacity of 1,050,000 tons. It has been computed that from the one fact of using these cars in place of the old wooden car of smaller capacity, the saving effected on the said load of 1,050,000 tons, at the rate of 11,300 kilometers a year and 0.94 per kilometer ton, represented something like 26,000,000 francs—that is to say, that if all the traffic of the United States was carried in pressed steel cars of large capacity and light weight a yearly saving of 765,000,000 francs would result.

There is, therefore, nothing surprising in the fact that the Pressed Steel Car Company, whose business three years ago hardly amounted to $500,000 (2,500,000 francs) should have raised its production in so short a space of time to the incredible figure of $30,000,000 (150,000,000 francs), at the rate of 100 cars, or 1,500 tons of steel, per day. Three years ago the company employed 500 men, now they employ 10,000—that is to say, that something like 50,000 individuals are dependent upon its business for their livelihood.

That is what activity, backed by an untiring energy, and perseverance can be done by a single man, in spite of the greatest difficulties which alone would have discouraged a man of less determination. More fortunate than most inventors, who so seldom live to see the final triumph of their work, Mr. Charles T. Schoen has been fortunate enough to be able to enjoy the glory, power and riches which he has acquired through grit and hard work, and to see his dream completely realized.

His exhibit in Class 13 of pressed steel cars (Paris Exposition), which does so much honor to American industry, is truly sensational. There is not a doubt that it will attract the particular attention of the jury of awards. The fact is, it will interest everybody, since the great point in question is no more nor less than the reduction of the cost of transportation—that is to say, finally the emancipation of industry and living at a lower cost. EMILE GAUTIER.

BOOKS AND PAMPHLETS.

American Railway Engineering and Maintenance of Way Association. Proceedings of the first annual convention held in Chicago, March, 1900. Mr. L. C. Fritch, Secretary, Monadnock Building, Chicago.

This pamphlet contains the constitution, list of members, officers, committees and the outline of the committee work of the association, in addition to the papers and discussions of the annual meeting. The object of this association, as stated in the constitution, is "the advancement of knowledge pertaining to the scientific and economical location, construction, operation and maintenance of railroads." Its field is wide and its opportunities for usefulness great. The first volume of its official record in every way promises a most successful organization.

"The Work Ahead." An address delivered by George B. Leighton, President of the Los Angeles Terminal Railway. Constituting one of the series on railway subjects given before students of the Engineering Department of Purdue University, 1899. Published by the University of Lafayette, Ind. Also "Notes and Suggestions from Experience in the Motive Power Department of Railways." By Richard H. Soule, Late Western Representative of the Baldwin Locomotive Works, in the same series.

Those who follow the work of Purdue University have learned to look for the publication of the addresses of outside lecturers with anticipation. One of the ways in which this institution keeps in direct touch with the affairs in which the graduate is preparing to take his part is to secure the ideas of men who have been successful in their particular fields of the world's progress. Having these men to look at, listen to and to meet has an effect upon the student which may for a time be unconscious, but it is enduring. It opens his mind to thoughts which can not be received in any other way, and it inspires as well as instructs him. He may perhaps forget every word of these addresses, but he never loses the inspiration gained by contact with successful men. We are grateful to Purdue for the opportunity of sharing some of these benefits with the student. The addresses are put into convenient form, and we hope to preserve all of them.

One Hundred Years of German Bridge Building, by George C. Mehrtens, Professor of Engineering, Kornigliche Technische Hochschule, Dresden, Germany; from the German by Ludwig Mehrtens; 135 pp., 195 engravings. Berlin, 1900: Julius Springer.

This book was written by Professor Mehrtens to represent German bridge building at the Paris Exposition. It was prepared for six of the leading firms of German bridge builders, and its purpose was to illustrate the entire field of bridge building in that country. It treats of the development of this branch of engineering with reference to theory, design and erection and presents a large number of examples with descriptions. But 500 copies of the German edition are to be sold. It has been translated into English and French and 1,000 copies of each of the editions are to be presented by request to engineers interested in the subject. The author deals with iron bridges and their materials; he gives a history of girder construction and discusses the theory of bridges. He shows the improvements which have been made in iron bridge construction and describes the shops and methods of the six building concerns referred to. The work is carried out with taste and care, and as the publishers have done their part well, the volume is handsome in every respect.

"Dynamometers and the Measurement of Power: A treatise on the construction and application of dynamometers." By J. J. Flather. New edition, revised, with the addition of new chapters and some of the old ones rewritten. Published by John Wiley & Sons, New York, 1900. Price, $3.

This book was written to supply technical students and engineers with a detailed description of the construction and means of application of the various types of dynamometers employed in the measurement of power. The earlier edition has been revised for the purpose of adding new types of dynamometers and bringing the discussions up to the present state of knowledge on the subject. Besides rewriting the majority of the old chapters and giving considerable new material on the Venturi meter and on meter testing, five new chapters have been added, four of which are devoted to the measurement of electric power, which includes a general consideration of the subject, together with a discussion of electric measuring instruments and methods in use for determining the power and efficiency of direct and alternating-current motors. The fifth additional chapter is on the power required to drive machinery, of which the electric motor, in the group system and individually, is a prominent factor, and this part contains a very extensive and valuable table of the records of horse-power required to drive all ordinary machine-shop tools and wood-working machinery of various kinds and under different conditions. The scope of this book has thus been greatly enlarged and it is not only a very valuable book to the technical student, but to engineers in general.

The Chicago Pneumatic Tool Company have issued a special catalogue showing in excellent half-tone engravings their exhibit at the Saratoga conventions. A comparison of the exhibits of this company from year to year illustrates in an impressive way the growth of their business. This year the space occupied and the number of devices exhibited far surpassed previous efforts and the number of applications of pneumatic power to labor-saving devices continues to increase. This catalogue illustrates in detail the chief of the specialties of these manufacturers in wood and iron working tools, staybolt cutters, oil furnaces, flue cutters, air jacks and spraying machines for paint.

The Joseph Dixon Crucible Company, Jersey City, N. J., have issued a pamphlet of ten pages on the subject of graphite facings for foundry work. These facings are made in a large variety to suit various conditions of foundry practice, and they have as a basis the celebrated graphite controlled by this company. The object sought is to produce a facing for molds which will coat the sand and produce smooth finished castings. It must burn in order to secure the best results, and in burning, a thin film of gas is formed between the melted iron and the sand. This film must be sustained until the iron is cool in order to prevent the adhesion of the metal and the hard spots so frequently found in castings. Graphite is particularly well adapted to secure this result. Nine varieties are described in the pamphlet.

Fittings for Steam Vehicles, manufactured by the Ashton Valve Company, 271 Franklin Street, Boston, are briefly described in a small pamphlet which has just been issued. The devices described are pop safety valves, cylinder relief valves, steam or air gauges, duplex steam and air gauge, common water gauges, compression gauge cocks and Ashton pet cocks. Each of these is briefly described, and sizes and prices are given.

The Dustless Roadbed Process.—The Q. & C. Company have issued a small pamphlet, describing the dustless roadbed process, which consists of spraying a heavy oil over the roadbed by means of a sprinkler attached to an ordinary flat car. The oil is manufactured especially for this purpose by the Standard Oil Company. It has a high fire test and low gravity, which renders it free from danger of combustion. The faint odor which accompanies a fresh application of the oil is not disagreeable and entirely disappears in a few days. Many advantages and claims of economy are made for this oil. The rates for licenses under patents, including use of oil, also right to build and use patented sprinkling machinery to be attached to a flat car, can be obtained on application to the offices of the Q. & C. Company, 700-712 Western Union Building, Chicago.

Hand Book of Injectors.—This little book presents in a form convenient for the vest pocket, the information which users of injectors need to have at hand with regard to the construction and operation of this type of boiler feeder. It is issued by the Injector Department of Messrs. Wm. Sellert & Company, Philadelphia. Its purpose is to give assistance to those who would like to turn to a convenient reference in repairing an injector in a hurry, and it gives in condensed form the theory of injectors in general, and describes in particular the construction of injectors made by this firm. Tables from tests of locomotive injectors present figures of capacity, range and limiting temperatures, and a brief discussion of "How to use an injector to save fuel," near the end of the book, should be brought to the attention of those who handle injectors on locomotives and those who are directly responsible for the consumption of locomotive fuel.

The Torrey Ballast Car.—The Q. & C. Company have sent us a circular illustrating the Torrey Ballast Car, the control of which they have just acquired. The car is part of a very interesting and successful system for loading and distributing gravel and rock ballast from freight trains. Of the special features of the car, the double side doors and the type of locking device are examples. The Q. & C. Company have made arrangements with Mr. A. Torrey, Chief Engineer of the Michigan Central and designer of the Torrey Car, under which "they are prepared to grant licenses to railway companies and contractors, to manufacture or use cars built in accordance with this patent and solicit correspondence with all who are interested in this method of distributing ballast. Mr. Torrey's idea is to use these cars in local freight trains without requiring special work trains for distributing ballast. He also uses a special loading machine which seems to give satisfactory results.

The Morse Twist Drill and Machine Company, New Bedford, Mass., have issued a new catalogue of 120 pages illustrating and describing in great variety the product of their works. The engravings are excellent and each item is described in a table of dimensions which will be exceedingly convenient in ordering. The well-known specialties of these manufacturers are all shown, including a large variety of increase and constant angle drills, twist drills, reamers, chucks, milling cutters, dies, tube and other tools for machinists. We should say that every tool room, as well as shop manager's desk, should be supplied with a copy of this pamphlet. The plant of the T. & B. Tool Company, of Danbury, Conn., was purchased by the Morse Twist Drill and Machine Company in 1848. It has been moved to New Bedford and is now in operation. The style of drill formerly made by the T. & B. Tool Company will continue to be furnished under the name of "Constant Angle," the details of which are given in this catalogue. The catalogue is indexed. It is standard, size 6 by 9 inches, and is well printed on excellent paper.

Narrow Gauge and Industrial Railway Materials and Locomotives.—Arthur Koppel, manufacturer of narrow gauge railway equipment, 66 Broad street, New York, has sent us a copy of his "1900 Album," illustrating by aid of a large number of engravings the very extensive use to which the equipment he furnishes has been put in various parts of the world. Mr. Koppel has for years made a specialty of light railway equipment for factories, mines, docks, mills, furnaces, navy yards and, in fact, every sort of work requiring light railway equipment, whether steam, electric or rope driven. The album is divided into four parts, illustrating the Koppel equipments in use in Europe, Africa, Asia and North and South America. The descriptions are in six languages and the album conveys the impression of an exceedingly extensive business in all parts of the world where engineering operations are carried on.

Superior Graphite Paint is described in a little folder issued by the Detroit Graphite Manufacturing Company. This paint is made from Lake Superior graphite, from mines owned and exclusively controlled by this company. The success of this paint is said to be due largely to the peculiar character of the ore and the presence of certain valuable ingredients in it which causes the pigment to mix well and to stay mixed. We understand the chief advantages urged for this paint to be the following: Durability, freedom from chemical changes, absence of tendencies to crack or peel, ability to withstand heat, steam, vapor, water and gases. On iron work it is advocated for protection for surfaces which are covered up in construction so that they cannot afterward be inspected. It seems to be unaffected by the cements and plasters, lime or other materials used in building, and it is stated that even when spots of rust have already formed the paint, properly applied, will absorb the oxide and prevent further oxidation. It is particularly recommended for bridges, cars, docks, ships, roofs, smoke stacks; and when applied to woodwork it has important fire-resisting qualities. In the pamphlet are a number of engravings of buildings, bridges and ships upon which it has been applied with gratifying results. This is a well-known paint with an excellent record.

EQUIPMENT AND MANUFACTURING NOTES.

PNEUMATIC TOOL LITIGATION.

To the Editor:

Inasmuch as it has been called to our notice that a large number of users and prospective users of pneumatic tools are under the impression that suit has been entered against us by one of our competitors for infringement of their patents on account of the fact that they have brought suit against various pneumatic tool companies, we wish to notify the trade in general through your publication that we are not involved in any way, shape or manner in the present litigation, as our "Little Giant" pneumatic tools are fully covered by patents, the validity of which is not questioned by anyone.

Yours very truly,
STANDARD PNEUMATIC TOOL CO.

Chicago, August 15, 1900.

The American Locomotive Sander Company, of Philadelphia, has obtained control of the "Sherburne" sander, which was heretofore handled by the Automatic Track Sander Company, of Boston; this company having retired from the business and Mr. Sherburne becoming a stockholder in the American Locomotive Sander Company.

The Pearson Jack Company was known to have an extensive business in the sale of car repairing jacks and other specialties, but we are impressed with the fact that these devices are in demand abroad by the receipt of catalogues in French, German and Spanish. Mr. A. H. Richardson, manager of the company, is to be congratulated upon the success he has made.

The Richmond Locomotive Works have received an order for twelve 16 by 24-in. 10-wheel passenger locomotives from the Finland State Railways. This is the third order at these works from the Finland State Railways. It is a gratifying expression of satisfaction with American locomotives and with the product of the Richmond Locomotive Works.

The Ingersoll-Sergeant Drill Company of New York has received the Grand Prize at the Paris Exposition for their Mining Exhibit, the gold medal constituting this prize being the highest award given.

The Chicago Pneumatic Tool Company has engaged Mr. Fred F. Bennett as sales agent and manager of advertising, with headquarters at the main office of the company, Monadnock Block, Chicago. Mr. Bennett resigned his position as sales agent for the American Steel Casting Company and American Coupler Company of Chester, Pa., the change taking effect July 1. Mr. Bennett seems to be peculiarly adapted to his present position. His apprenticeship of several years was served on the Chicago daily papers as reporter and city editor, and later he was city editor of the Omaha Republican. Subsequent to this he was for many years Western Representative of the Railroad Gazette. His long experience in the journalistic field, his railroad acquaintance, combined with his thorough knowledge of trade publications, should make him a valuable acquisition to the staff of this company, and they are to be congratulated on securing his services in a department of their work for which he seems peculiarly qualified.

The Naval Electric Company, with offices at 95 Liberty Street, New York City, has been organized to succeed the B. & H. Electric Company of Dansville, N. Y., and New Haven, Conn. The same officers continue, the new name being more appropriate for the distinctive line of electrical business in which the company proposes to engage. F. G. Hall, Jr., A.S.M.E., is the Manager for the company, and I. E. Burdick, Secretary and Treasurer. Both gentlemen have been engaged in the electrical business for about ten years, and have devoted their attention more especially to the application of electricity to naval and marine purposes. These gentlemen have jointly invented an arc lamp for use under water, which is known as the Yale Submarine Arc Lamp. This lamp has proved its entire practicability for submarine use in connection with divers, and is being used by wrecking companies, dredging companies, dike and bridge builders, sponge and pearl fishers, in navy and dock yards, railroad docks, ship yards, and by the United States and Russian governments. It is being placed on the market by the company, who are negotiating for its adoption in foreign navies, and by various steamship companies at home and abroad.

At a recent meeting of the stockholders of the Consolidated Railway Electric Lighting and Equipment Company, held at 100 Broadway, New York, the following Board of Directors was elected: Walther Luttgen, Norman Henderson, C. G. Kidder, George W. Knowlton, Thos. J. Ryan, Isaac L. Rice, John N. Abbott, Aug. Treadwell, Jr. The vice-president and general manager of this company, John N. Abbott, was formerly General Passenger Agent of the Erie Railroad and subsequently for several years Chairman of the Western Passenger Association of Chicago. This company is a consolidation of the various companies heretofore engaged in the manufacture of electric lighting apparatus for all kinds of steam railway cars, the electricity being generated from the car axle while the car is in motion and furnished from a storage battery while the car is stationary. This system is known as the "Axle Light" system of electric lights and fans for railway coaches, and is in operation on various railway lines.

The Shickle, Harrison & Howard Iron Company, a company organized in 1867, having for the past few years done a very prosperous business, have found their old quarters in St. Louis (near the Union Station) inadequate to meet the growing demand for cast steel products, and have purchased a fine site in East St. Louis, and have built thereon one of the best and most up-to-date steel castings plants in the county. This has been in operation for some forty days, and is turning out an enormous amount of steel, and is working beautifully. This plant is a great addition to the steel-producing world of to-day. They make all kinds of railroad, street car, mining machinery, electric machinery and other kinds of castings, making a specialty of freight car trucks and body bolsters. The new plant has been visited by many prominent engineers and mechanical people, and pronounced one of the best of its kind in this country. This firm has also opened agencies in foreign countries, being represented by Sanders & Co., of London, who have a world-wide reputation. The Shickle, Harrison & Howard Company is in the front rank of the great steel producers. They are operating their plant in East St. Louis and the one in St. Louis. Mr. John W. Harrison, president, is one of the best known foundry men in the world. Mr. Geo. B. Leighton, president of the Los Angeles Terminal Company, is a very large owner in this property, and is a very bright, capable man. Mr. John M. Harrison, vice-president and general manager, is a prominent and progressive young St. Louis man, who has met with wonderful success in the management of this business. The sales department of the company is managed by Vice-President Clarence H. Howard, who has met with phenomenal success in the different positions which he has filled heretofore. He has many friends who recognize his business abilities and genial character.

The Pearson Jack Company, of Boston, inform us that they have acquired a license from the United States Car Moving Device Company, of Lowell, Mass., for the sole manufacture and sale in the United States and foreign countries, of the United States Car Pusher and that in the future this device will be handled with the regular line of specialties of the Pearson Jack Company. We have seen a number of letters from those who have used this car pusher and they are universally favorable. The device is compact and self-contained and is admirably adapted to the requirements of those who desire something which will enable them to move cars easily through short distances.

Switzerland, "The playground of Europe," is visited annually by over 15,000 American tourists and invalids. Why? While the Alps have isolated peaks such as Mont Blanc (15,781 ft.), and the Matterhorn (14,836 ft.), the mean elevation of the highest Alpine chain is from only 8,000 to 9,000 ft. Colorado possesses more than 120 peaks over 13,500 ft. in altitude, of which no fewer than 35 peaks range from 14,000 ft. upward. In the whole of Europe there are not over 12 mountain peaks of note. The highest village in Europe is Avers Platz, in Switzerland (7,500 ft.); the highest inhabited point in Europe is the Hospice of St. Bernard in Switzerland (8,200 ft.). In Colorado the mining town of Leadville, with 15,000 inhabitants, is 10,200 ft. above sea level; other mining camps are still higher, and some gold and silver mines are worked at an altitude of over 12,000 ft. The highest wagon road in Europe is said to be the Stelvio road in Switzerland (9,170 ft.). In Colorado the railroads cross the crest of the continent at Fremont Pass (11,328 ft.), Marshall Pass (10,852 ft.), and Tennessee Pass (10,433 ft.). Switzerland does not possess, even in the famous St. Gothard line, any railroad engineering surpassing, if equaling, these. There are wagon roads over numerous passes in Colorado ranging from 12,000 ft. upward, the highest being Mosquito Pass (13,700 ft.). In Switzerland the cog railroad from Vitznau to the summit of the Rigi Kulm (5,900 ft.) has a length of four and a half miles, in which the ascent is 4,072 ft. In Colorado the cog railroad from Manitou to the summit of Pike's Peak (14,147 ft.) has a length of eight and three-quarter miles, in which the ascent is 8,100 ft., or an average of 846 ft. per mile, the maximum grade being 1,320 ft. One class of Switzerland's finest scenery is along the Via Mala, the Schyn Pass and Urnerloch. In Colorado, the Canon of the Arkansas, with the Royal Gorge, the Black Canon of the Gunnison, the Canon of the Rio de las Animas, the Canon of the Grand River, and others, are all much longer, quite as grand as and more varied in character than the best passes in Switzerland. The walls of the canons of the Grand River, the Gunnison and the Arkansas rise to a sheer height of more than 2,000 ft. As Colorado can be reached by at least one railroad—the Burlington—in one night from either Chicago or St. Louis, it is hard to understand why more Americans do not travel West instead of East in search of health and pleasure.

WANTED.—Copies of the "American Engineer, Car Builder and Railroad Journal," one of the June, 1896, issue, also one of the January and May issues of 1898. Fifty cents will be paid for a complete copy of each sent to the Editor, 140 Nassau Street, New York.